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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

NOVEMBER 1954

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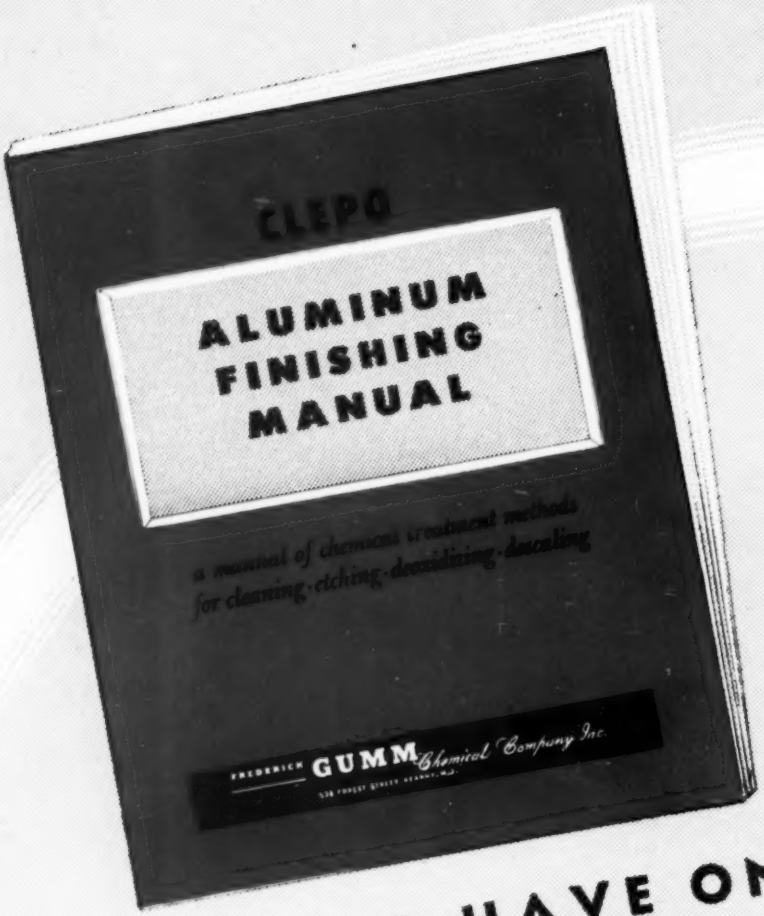

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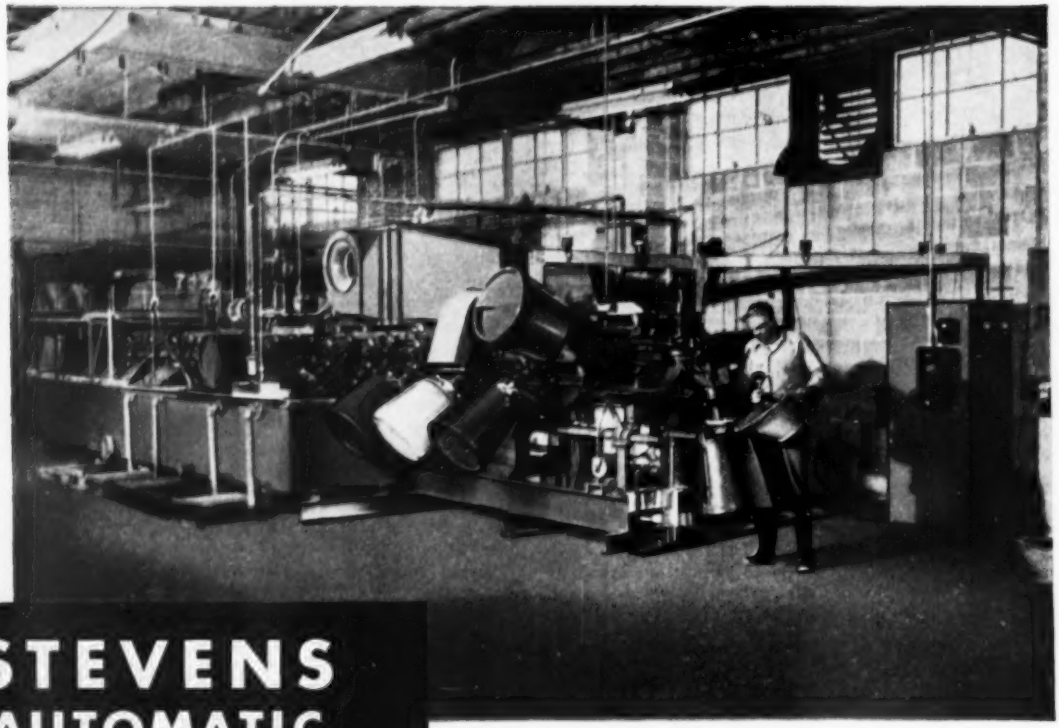

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Journal of the American Electroplaters' Society

November 1954 **Vol. 41, No. 11**

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This Month's Cover . . .

shows a load of electric clock parts that have been deburred. Photo courtesy Norton Company, Worcester, Mass.

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L—100. Plating Rectifiers—A new 8-page, 2-color, illustrated bulletin No. 5500 contains helpful hints on installations of plating rectifiers, describing different arrangements best suited for certain installations. Descriptive photographs are included to demonstrate the different arrangements. Valuable information concerning the desirable features of top-quality rectifier construction is outlined in detail. It shows the new drip-proof laboratory models together with a complete description of the other various types of rectifiers that are available for electroplating and anodizing. The bulletin also gives a brief discussion of the history and present facilities of the Ther Electric & Machine Works, publishers of the bulletin.

L—101. Metal Finishing Literature—Three bulletins of interest to the metal finisher have been released by The Swift Industrial Chemical Co.

The bulletins cover: (1) Zinc brighteners. New zinc addition agents for both barrel and steel tank zinc plating are described; (2) Chromate finishes. New chromate finishes for zinc, cadmium, and aluminum are detailed; (3) Plating products. The folder describes Promat products for zinc, cadmium and copper plating; white brass plating; metal pickling and cleaning and chromate finishes.

L—102. Coated Abrasives—A two-page leaflet has just been published by Behr-Manning Corporation. The leaflet describes the new additions to the company's abrasive tools.

L—103. Catalog Covers Line of Industrial Protective Coatings—The Ceilcote Co. has announced the publication of the new 8-page illustrated catalog No. C-150. Purpose of this publication is to simplify the complex problem of selecting the correct protective coating for various industrial installations. A special feature of the catalog is the protective coating properties chart which presents complete information on each coating in concise form. In addition to formulation, temperature resistance, drying time, and coverage, the ability of each coating to resist 18 commonly encountered chemicals is indicated.

L—104. Maintenance Cleaning Guide—How-to-do-it charts based on actual in-plant maintenance procedures are a feature of the new "Plant Maintenance Cleaning Guide" recently published by Oakite Products, Inc.

Designed for quick reference, the charts list recommended cleaning materials, methods of application, concentrations and temperatures for such specific operations as cleaning, and treating the water in, air conditioning and refrigeration units; cleaning compressors and condensers; descaling diesel water jackets and water-cooled furnaces; cleaning floors, oil heaters and coolers, windows and light fixtures; controlling mold and odors; stripping paint from machinery and transformers; and removing rust. The booklet also describes Oakite cleaning materials, Oakite Solution-Lifting Steam Guns, and the Oakite Hot Spray Unit.

L—105. Vacuum Furnaces—Vacuum furnaces have added about 30 metals to the industrial spectrum, including titanium, zirconium, germanium, and similar rare metals, as well as the more common copper, iron, and steel in new high-purity forms with properties so greatly improved as to deserve being called new metals.

A new brochure, released by F. J. Stokes Machine Co., discusses at length this rapidly growing new field of vacuum metallurgy and includes a comprehensive treatment of the effects of processing various metals and alloys in vacuum. It also includes descriptions, with drawings, of the several types of vacuum furnaces Stokes is now building, with particular emphasis on resistance-heated furnaces with movable heat source, tilting-type furnaces, and movable-retort furnaces.

L—106. Guide to Finishing and Plating Racks and Tips—A free 24-page catalog providing a ready source of information on racking methods and tip constructions for plating and finishing has been released by NARACO.

The book describes fundamental tip or work holder forms and basic racking procedures. It is meant to constitute a background for suggesting the correct approach to any specific problem.

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Editorial

Will You Give a Minute to Your Society?

THE philosophy of membership promotion in the AES is simple. It consists in bringing the advantages of membership to the attention of suitable prospects. Those who are really interested and will profit thereby, will join.

It is not necessary to discuss here the many benefits and advantages of membership in the AES.

However, it is a fundamental fact that membership growth is necessary for a stronger Society that is to expand and increase its services to its members and the industry.

The important thing then is to reach these suitable prospects. Who are they? Where are they? Should we "appoint a committee" or appeal to the members-at-large? It seems to me that the answer "in ourselves doth lie."

Would you, therefore, take a minute to fill out the card that appears on the preceding page with the Reader Service Card and mail it to AES Headquarters? They, in turn, will send out literature and have the prospect's name put on the mailing list of his nearest branch to receive meeting notices. There will be no "high pressure" salesmanship. Your name will not be mentioned.

Certainly, there must be someone you know in the field who would profit by association with the AES, by attending meetings and by ultimately joining the Society. It is a fact that many people have not joined because they have never been asked!

Your small effort multiplied by 6429 will have impressive results.

Give your Society a minute of your time by filling out and mailing the card—NOW!

Samuel Heiman

SECOND VICE-PRESIDENT, AES

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Industry News

Wagner Brothers Occupy New Manufacturing Plant. Wagner Brothers, Inc., manufacturers of metal finishing equipment and supplies, have consolidated all equipment manufacturing facilities in a new plant at 7800 Dix Road, Detroit.

Manufacturing operations formerly carried on at several smaller, separate locations in Wayne and Detroit will now be done at the Dix Road plant. These manufacturing operations include fabrication of automatic and semiautomatic plating machines, rectifiers, liquid filters, transformers, precision hard chrome plating machines, and plating barrels and the construction of steel tanks and linings.

Wagner Brothers' main office is still located at 425 Midland Avenue, Detroit 3, Mich.

Stevens Appointed Uscolite Distributor. Appointment as national distributor in the United States and Canada to the metal finishing industry for Uscolite—the new thermoplastic type piping, fittings, and valves manufactured by the U. S. Rubber Company—has been announced by Guy A. Cummings, metal finishing sales manager for Frederic B. Stevens, Inc.

Uscolite pipe is rigid, tough, lightweight, and corrosion-resistant. It can be cut and threaded with standard equipment. It is nontoxic and chemical resistant, serving well for sensitive chemical solutions, deionized and demineralized water, plating solutions, and waste treatment.

General Electric to Exhibit at 36th National Metal Exposition. Five General Electric Company apparatus departments will exhibit the latest electrical equipment for the metals industry at the 36th National Metal Exposition, sponsored by the American Society of Metals, in Chicago's International Amphitheatre, November 1 through 5.

The G-E exhibit, measuring more than a thousand square feet in area, will be sponsored by the company's industry sales department.

The exhibit will be staffed by W. V. Gough, R. E. Cragnolin, and E. C. Vrooman of G-E industry sales. George Be-Qua will represent the company's exhibit unit.

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Industry News

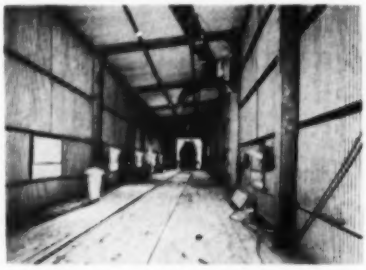
Detrex Opens New England Office. The Detrex Corporation of Detroit, manufacturers of chemicals and industrial metal cleaning equipment, has established a New England regional office in Meriden, Conn., W. F. Newbery, director of sales, has announced.

Headed by A. D. Chabot, New England region manager, the new Detrex office will serve Vermont, Maine, New Hampshire, Massachusetts, Connecticut, and Rhode Island.

A veteran of the metal cleaning field for 18 years, Chabot is a graduate of the University of Connecticut, where he received his B.S. degree in mechanical engineering.

The new office is located at 35 Colony Street in Meriden.

New Tank Car Lining Plant. A new tank car lining plant has been completed by the Industrial Lining Division, Edgeworth, Sewickley, Pa., a division of the Chase Chemical Corporation, Pittsburgh.



Completed this month, the new plant building measures 25 by 175 feet and houses four hopper or tank cars for lining at one time.

The plant was built to handle the increasing demand for Chase tank linings to haul acids, solvents, chemicals, and caustic soda.

This completes the current expansion program initiated last year, involving improved facilities for sand blasting, ventilating, lining, and curing the many types of Chase linings for tanks, tank trucks, tank cars, and barges.

Philadelphia FD Equipped to Extinguish Metal Fires. Most municipal fire departments are woefully unequipped to extinguish fires in burning metals, but not the Philadelphia Fire Department.

At the direction of Chief George Hink, the City of Philadelphia recently installed on its SS-100 all-purpose fire truck eight

Ansul-30 dry powder extinguishers capable of expelling 240 pounds of Met-L-X powder on burning metals.

Another truck, known as the SS-101, carries another 560 pounds of the powder, and Hink says that soon all engine companies, in whose districts there are industrial plants where the possibility of metal fires exists, will be similarly equipped.

Hink said the increasing use of magnesium, sodium, and other highly reactive metals in industrial processes and research led to the decision to carry these extinguishers.

Eltex Chemical Corporation Acquires Jetal Process. All rights to the Jetal process for blackening ferrous metals by oxidation have been acquired by the recently formed Eltex Chemical Corporation, Providence, R. I., according to Mark Weisberg, president. Weisberg has retired as president of the Alrose Chemical Company, subsidiary of Geigy Chemical Corporation, the post he held prior to the Alrose Company's merger with Geigy.

Eltex will manufacture and market Jetal and other chemical products, Weisberg states. The Jetal process, which he originated while president of Alrose Company, is a speedy blackening process for irons and steels, applied in approximately five minutes by an inexpensive immersion method. Permanence is said to be exceptional, as the Jetal finish will not chip, peel, crack, or dust off even if the metal is bent or cut. The process is low

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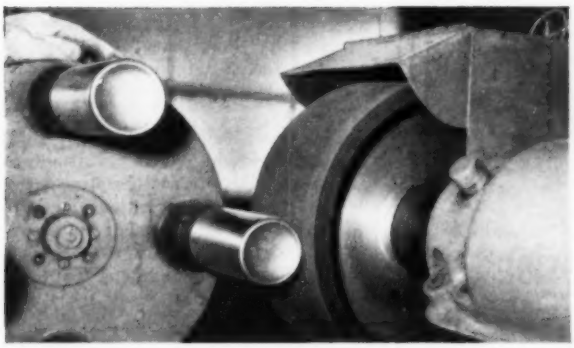
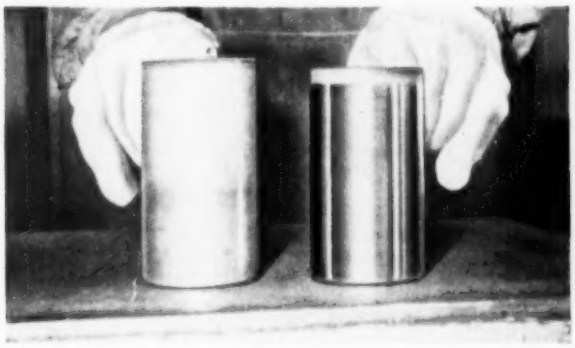
(1) Production Problem: To cut unit costs of grinding and polishing stainless steel whip-cream dispenser cans. Nilsen Mfg. Co. had been jobbing out the cans to an outside source, paying a high .08¢ per can, due to old-fashioned methods, labor, material and delivery costs.



(2) Solution: A 3M Representative recommended that this Addison, Illinois, manufacturer install the 3M Method, using Grit #180 Resin Bond Belts running over a special contact wheel. Cans were placed on automatic work holders.



(3) Results: An immediate reduction in polishing costs. By installing the 3M Method, and doing the work themselves, Nilsen Mfg. Co. cut costs to only $.0125 per finished unit . . . a saving of $.0675 per can! A 3M Representative can help you solve your grinding and finishing problems, too. His services are available without cost or obligation.

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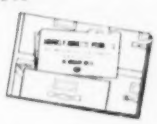

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Industry News

in cost and requires no electrical current as it blackens ferrous metals by chemical oxidation, giving a lasting black finish to all work, whether handled in bulk, baskets, or barrels.

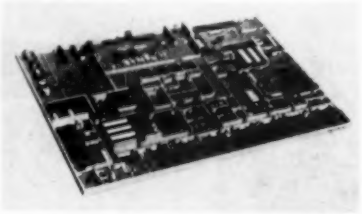
New Book on Chemical Development. Marking the first book on the subject ever written, the Commercial Chemical Development Association announces the publication of "Successful Commercial Chemical Development."

Prepared by committees of the CCDA and edited by H. M. Corley of Armour and Company, the 374-page book is intended to document "the important principles . . . in selecting promising new chemicals and rapidly developing them to the stage of economic importance." The book is believed to be the most comprehensive guide to organized chemical development ever prepared. It discusses in detail each step in the development of a product from the laboratory to commercial marketing and outlines some of the career opportunities in this expanding branch of the chemical industry.

Besides the technical steps involved, the book also devotes a number of chapters to other major phases of product development, including advertising, pricing, packaging, and labelling. A separate chapter discusses the toxicology, safety, and handling of new products.

Oakite Opens New Laboratories. Research and product development in chemical cleaning took another giant step on September 15, when Oakite Products, Inc., threw open the doors to their new and expanded laboratories at 350 Hudson Street, New York. An extensive look into the future of industrial cleaning materials and methods was the feature of the afternoon.

John A. Carter, president of the concern, and J. J. Basch, manager of research and product development, were on hand to welcome the visitors.



Guests and officials of the company took part in the opening ceremony and then toured the laboratories, which cover 30,000 square feet on a single floor.

The laboratory, which is subdivided into three major sections—product development, customer service, and engineering—will continue to devote itself to the cleaning and sanitation problems of the nation's production and service industries. In addition, a complete pilot plant is planned for the small scale manufacture of detergents and solvents prior to extensive field testing.

Addition to Stevens Ohio Plant Completed. A new addition to the Springfield, Ohio, plant of Frederic B. Stevens, Inc., metal finishing and foundry equipment manufacturers, was recently completed.

The new facilities have enabled the manufacturing operations to expand production of the Stevens complete line of automobile rack and automatic barrel plating and metal processing equipment.

The company's production of dryers and the new metal finishing waste disposal equipment will also be speeded up as a result of the expansion.

To serve Stevens customers better in the Ohio and central states area, provision was also provided for special warehousing facilities enabling more rapid delivery of plating and metal finishing supplies.

Marin Company Named Distributor for Carco. The Marin Company, Los Angeles, has been appointed as a national distributor for the Carco midget sand blast gun.

Used for fast and efficient sand blast, air, or liquid cleaning of small parts and surfaces, this gun has found many applications in industry.

It operates on any standard air pressure system, at 75 to 140 pounds pressure. Most efficient results are obtained at 100 pounds pressure. For sand blasting, silica sand, carborundum, granite grit, glass beads, or any other 30-mesh or finer material can be used.

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❶ improve color

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❸ eliminate supervision

❶ *color stays constant . . . no rejects*

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❸ *trouble free . . . only one addition instead of three*

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Special ratio materials for plating richlow brass or any other desired alloy of copper and zinc.

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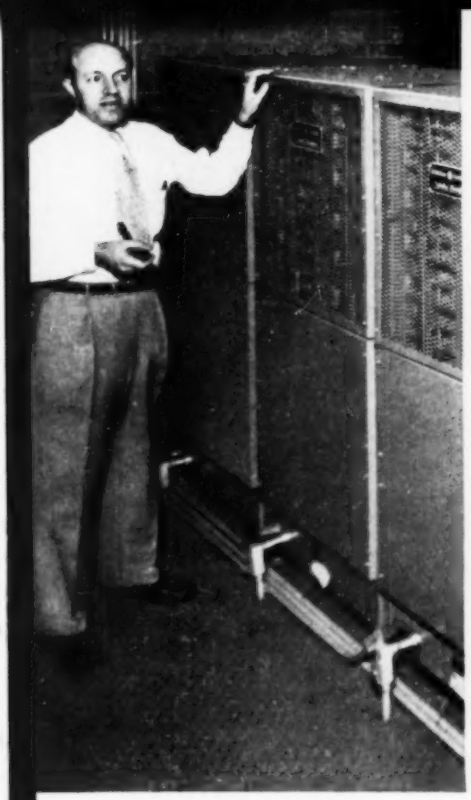

G-E RECTIFIERS located in a separate room leave more space for plating tanks, and avoid the corrosive atmosphere.

INSPECTING THE CONTROL STATION at one of the tanks where piston rings are being chrome plated. The operator's control station permits regulation of the voltage level at each tank by controlling the d-c output of the G-E rectifier units located in another room.

G-E Plating Rectifiers Help To Triple Capacity of Plating Room at Muskegon Piston Ring Co.

New General Electric plating power supplies have enabled the Muskegon Piston Ring Company of Muskegon, Michigan, to triple its plating capacity in the same working space. By mounting copper oxide rectifiers on an enclosed balcony outside the building, with a separate operator's control station at each plating tank, Muskegon was able to use the entire floor space for plating tanks.

COMPLETE FLEXIBILITY of plating room arrangements is provided by General Electric rectifier units. Not only is it possible to install the rectifiers away from the plating room, thus freeing space for additional tanks, but the rectifiers are kept clear of the corrosive plating room atmosphere as well.

LESS MAINTENANCE is required for G-E rectifier plating power supplies. The scarcity of moving parts means less maintenance, since only the cooling fan requires lubrication. Installation costs are less, since G-E plating rectifiers require no special foundation.

Operating costs are lower, because G-E rectifier units assure you of the most efficient application of either copper oxide or selenium with the proper circuit for each voltage rating.

AUTOMATIC REGULATION is available as an integral part of G-E plating power supplies, or can be added later to manually-controlled units. In addition to manually and automatically-controlled units, economical 12-volt barrel platers are available in ratings from 500 to 2000 amperes.

ADDITIONAL INFORMATION on any of General Electric's plating power supplies is available from any authorized G-E agent listed, or by writing Section 464-16, General Electric Co., Schenectady 5, N. Y.

G-E PLATING POWER SUPPLIES ARE SOLD BY THESE AUTHORIZED AGENTS:

AMERICAN FACTORS LTD., Honolulu, T.H.
M. E. BAKER CO., Cambridge, Mass.
BELKE MFG. CO., Chicago, Ill.
WILLIAM BUCHANAN SUPPLY CO., Cincinnati, Ohio
THE CHEMICAL CORP., Springfield, Mass.
CLEVELAND ELECTRIC CO., Atlanta, Ga.
CONNECTICUT ELECTRIC EQUIPMENT CO., INC. Meriden, Conn.
ENTHONE CO., New Haven, Conn.
FITZPATRICK ELECTRIC SUPPLY CO., Muskegon, Mich.
W. M. FOTHERINGHAM CO., Buffalo, N. Y.
GENERAL ELECTRIC SUPPLY CO., Cleveland, Ohio
FRED GUMM CHEMICAL CO., Kearny, N. J.
J. & H. ELECTRIC CO., Providence, R. I.
LASALCO, INC., St. Louis, Mo.
LEA MANUFACTURING CO., Waterbury, Conn.
WILLIAM LYNN CHEMICAL CO., INC., Indianapolis, Ind.
MEAKER CO., Cicero, Ill.
CARL F. MILLER CO., Seattle, Wash.
J. C. MILLER CO., Grand Rapids, Mich.
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STANDARD PROCESS CORP., Chicago, Ill.
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The Marlin Firearms Co., "Famous for Fine Guns since 1870", has long depended on Du-Lite black oxide for an attractive finish that will be dimensionally stable throughout the life of the gun.

The Du-Lite process provides intricate precision parts with a durable, rust-resistant black oxide finish. And since Du-Lite penetrates the metal, all crevices and knurls are protected without affecting dimensions or fit.

If your target is durable, attractive, economical finishing, you'll want to know more about Du-Lite black oxide.

Whatever your cleaning or finishing problem—**Depend on Du-Lite.**

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Send more information on Du-Lite..... ☐
Send information on metal finishing products.. ☐
Have your representative call..... ☐
Name .....
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City ..... Zone ..... State .....
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Only "Help Wanted" and "Situations Wanted" will be accepted. Rates: $.20 per word, minimum $5.00. AES branch members and members-at-large, in good standing, are entitled to a total of three *free* advertisements in one year. Last day for inserting advertisements is the 10th of month preceding date of publication. When answering advertisements please address as follows: Box number, PLATING, 445 Broad Street, Newark 2, N. J.

SITUATION WANTED—Man, 28, who specializes on zinc die casts with copper, bright nickel, and chromium, desires position with company offering right opportunities. Reply to: P-1154-A, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Metal finishing supervisor experienced in polishing, buffing, roto finishing, burnishing and cadmium zinc. Copper, nickel, chrome electroplating. Reply to: P-1154-B, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Plant manager desires change to organization with greater opportunity. Technical degree plus 15 years experience in management and engineering, manufacturing and job shop specializing in polishing, plating and painting. Thorough knowledge of all standard plating and polishing machines. Proven ability in low cost production, planning, inventory control and quality control. Reply to: P-1154-C, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Finishing Engineer, graduate chemical engineer with five years finishing experience wants job in development or production laboratory. Currently an officer in local branch of AES. Prefer location east of Chicago. Reply to: P-1154-D, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Metal Finishing Engineer, technical and administrative experience nearly all types of plating, anodizing, phosphate coating, painting. Chemical and metallurgical background. Technical Service, trouble shooting and control laboratory experience. 39 years old, married, family. For resume write to P-1154-E, PLATING, 445 Broad St., Newark 2, N. J.

WANTED—Sales Representative, for Cleveland area, by long established manufacturer and distributor of plating and polishing equipment and supplies. In reply give technical background and experience. All inquiries will be handled confidentially. Reply to: P-1154-F, PLATING, 445 Broad St., Newark 2, N. J.

WANTED—Young chemical engineer, chemist or metallurgist with knowledge of electroplating and interest in sales promotion. Work in New York City, available for traveling. Submit complete resume of training and experience, photograph and salary desired. Reply to: P-1154-G, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Desire to relocate in N. J. or N. Y. area. Thorough knowledge of all phases of electroplating; chemical processing; metal surface treating; organic finishing; quality control, statistical & laboratory; process control, time & motion, methods, process study. Prefer management position. Reply to: P-1154-H, PLATING, 445 Broad St., Newark 2, N. J.

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LUSTER-ON has consistently offered greater uniformity of results — for less cost. LUSTER-ON has offered better control in use than imitative coatings.

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When you deal with The Chemical Corporation you deal with a solid, well-financed company. You deal with a company built and growing on teamwork and service. You deal with a company vitally interested in its customers, doing that little bit "extra" that assures satisfaction.

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YOUR DIE-CASTINGS!

*Satisfied with your Finish?

*** looking for the best finish possible within the range of competitive production costs?**

Investigate our Lea-Ronal Bright Copper Process with Lea Copper-Glo.

You can secure the same following advantages as the numerous present users of the Lea-Ronal Bright Copper Process:

- **it produces a brilliant, soft ductile deposit, ideal for subsequent bright nickel or chrome plating.**
- **it reduces nickel requirements because nickel is not needed to build brightness.**
- **high speed plating.**
- **the brighteners are completely stable—even when idle for prolonged periods.**
- **carbonates tolerated to saturation without any harmful effect on plating range.**
- **can operate with mechanical or air agitation.**

There are other advantages but these six—all outstanding—will give you an idea as to what you can expect if you convert your tanks—still or barrel—to the Lea-Ronal Process using Lea Copper-Glo. Ask for a laboratory test sample. Better yet, order sufficient quantity to make a good trial production run in your plant. **Write or phone The Lea Mfg. Co., 16 Cherry Avenue, Waterbury 20, Conn., through whom the Lea-Ronal Bright Copper Process and Lea Copper-Glo are exclusively marketed.**

If you have a technical problem on copper plating on which our engineering staff could be of help, tell us about that, too.

Lea-Ronal, Inc.

Sales and Manufacturing Plant:
237 East Aurora Street, Waterbury 20, Conn.
Main Office and Laboratory:
42-48 27th Street, Long Island City 1, N. Y.

Personals

Eugene R. Oeschger, general manager of the General Electric Company's foundry department, and **Alfred E. Blake, Jr.,** manager-engineering, foundry department, are on a tour of 16 European foundries in nine countries.

"This trip is designed to investigate the latest technological advances in the European foundries and to exchange ideas and know-how on foundry methods and facilities," according to Oeschger, who is also a national director of the American Foundrymen's Society.

"We understand that Germany has made great strides in the foundry art in recent years and we plan to visit four plants in Dusseldorf," Oeschger added.

In addition, their itinerary calls for visits to foundries in France, Belgium, Switzerland, Italy, Sweden, Norway, Scotland, and England.

Lucas P. Hart, Jr., has been appointed manager of manufacturing for the General Electric Company's capacitor department at Hudson Falls, according to an announcement by **A. W. Hough,** general manager of the department. Hart, formerly manager of manufacturing facilities and engineering for the department, succeeds the late **J. T. Holleran.**

Harold C. Jenseth has been appointed plant manager of the San Francisco plant of General Electric's distribution assemblies department, according to **C. K. Skinner,** the department's manager.

With General Electric since 1945, Jenseth is a graduate of General Electric's engineering test program. While participating in this program, he held a variety of engineering positions, including assignments in welding, industrial heating, aeronautical and ordnance, and industrial control operations.

In 1947 he was appointed service engineer with the General Electric service shop in Seattle, Wash. Early this year Jenseth was named supervisor of engineering in the Seattle plant of the distribution assemblies department, a position he held prior to his present assignment.

Jenseth was born in Petersburg, Alaska. He was educated in Seattle schools and is a graduate of the University of Washington, with a B.S. degree in mechanical engineering.

Clarence G. Bieber has been appointed head of the special alloys section; **George R. Pease,** head of the welding section, and **W. W. Sellers,** head of the electrochemical section at the Bayonne research laboratory of the International Nickel Company, Inc., it has been announced by **Dr. W. A. Wesley,** manager of the laboratory.

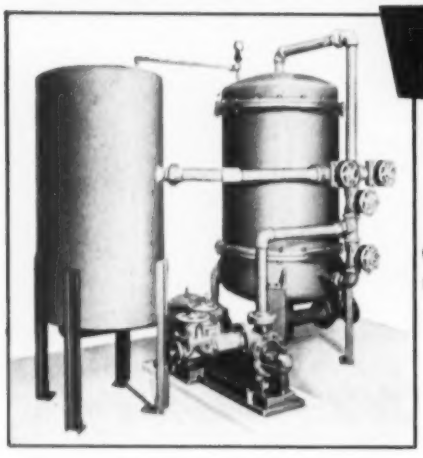
Bieber **Pease**

Sellers

Bieber, who received his technical education at the University of Wisconsin, joined the staff of Inco's Huntington, W. Va., Works in March 1924, and in 1939 he became works metallurgist, the position he held prior to his present appointment. Bieber's studies in the melting, deoxidizing, and refining of nickel alloys have resulted in the issuance of 18 United States patents, with a number of patents pending. Many foreign patents have also been issued in his name. He has been an active member of the American Ordnance Association.

Pease is a M.S. graduate of the University of Massachusetts. He was a chemist with the Springfield Armory of the U. S. Army Ordnance Department from 1939 until 1945, when he joined the staff of

WAGNER BROTHERS FILTERS OFFER



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LOW OPERATING COST
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Consider two factors before you specify filtering equipment:

1 The gallons of solution which can be efficiently filtered in a given period of time.

2 The cost of maintaining the filtering mechanism.

It's an established fact that Wagner Brothers Filters have a higher effective flow rate than any other equipment with *equal filtration area* . . . thus, gallon for gallon, it delivers *more* pure filtrate *per hour* at a lower unit cost. Sludge and other impurities (down to 1/10 micron) injurious to your plating quality are removed when the bath or solution is pumped through permanent membranes caked with a few cents worth of filter-aid (diatomaceous earth).

To clean, you simply turn a few valves and reverse the flow. Air bump backwash shocks the caked filter-aid from the membranes and through the sludge drain. Maintenance costs are reduced to ½ that of ordinary industrial filters since there is no messy replacement of bags, sheets or pads, no manual cleaning labor, no dismantling.

Standard models are available in capacities from 560 GPH up, filter areas from 3 to 100 square feet.

We design and build specials to suit your requirements. Write for detailed information and filtering questionnaire. If you're a plating equipment distributor, ask about territories open.

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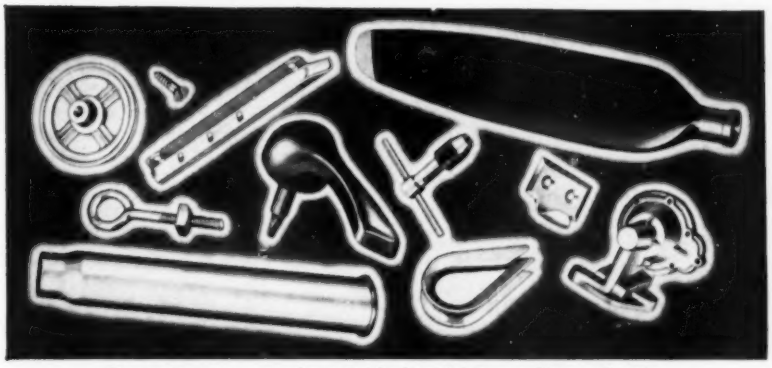
COATINGS for METALS
Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

Extra opportunities to cut costs with zinc finishing

Wider choice of corrosion resisting chromate finishes being offered



Some of the many products finished in Unichrome Dips or Anozinc

CHROMATE treating still remains one of the best ways to finish zinc die castings or zinc plated steel. It strengthens corrosion resistance. It's an *easy* way to finish. It's economical. And time has proved its quality.

With such a combination of virtues offered in a finish, it pays designers, metal finishers and production men to review their products—and to evaluate the benefits of chromate finishing against their finishing requirements. Especially today—when the pressure is on to cut costs every possible way.

Through the unusually wide choice of finishes United Chromium provides, even greater benefits become possible. Here's why. A more economical dip solution may be chosen. Or a production advantage may be realized.

FOR EXAMPLE:

The right Unichrome Dip meant half the material consumption and longer solution life to one company.

Brighter finish on zinc plated hardware with less solution-waste was gained in another plant with still another compound.

Chromate treating of zinc plated steel shell cases done electrolytically with Anozinc is found best and cheapest in the long run by many producers.

HERE IS VARIETY

Unichrome chromate finishes offer a good color choice. Lustrous, clear bright finish or black—brassy yellow or olive drab—even brass-color—all these can be produced chemically by Unichrome Dip solutions.

Unichrome chromate finishes also satisfy production method requirements. Compounds are available for manual or automatic operation.

An exclusive electrolytic process, Anozinc* rounds out this complete line of conversion coatings. It's found especially economical in continuous, large run automatic production. This process permits finished parts to be handled while wet.

Write for more data. *Trade Mark

NEW SAVINGS IN COPPER PLATING

New addition agents for use with Unichrome Pyrophosphate Copper have eliminated buffing for many users, made it easier for others who prefer to buff copper rather than the base metal or subsequent deposits. Plating speed has been increased—by as much as 20% in some cases. Need for expensive waste treatment prior to disposal are also being reduced because the bath contains no cyanide.

Lasting paint jobs can be applied overnight

Many plating plants are doing painting that gives 3 or more years protection against plating acids, cleaning solutions, and moisture. This cost-cutting durability is being achieved with Ucilon* Protective Coating Systems which are designed not only to withstand severest service conditions but also to apply fast. Coatings dry to touch in about 10 minutes. A complete job with the required number of coats for the service can easily be done overnight, thereby avoiding any downtime. *Trade Mark

HELPFUL HINTS
by "Mr. Cost Cutter"

One of the finest coatings possible for degreaser dipping baskets is provided by vinyl plastisol compounds because their heavy, resilient build-up prevents scratching of parts. Platers now using Unichrome Coating 218X for racks have one of the finest plastisol formulations available for these baskets, too. This coating withstands all plating solutions and provides unusually long service in vapor degreasing cycles!

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BECKMANODIZING

the new term in plating plants everywhere for accurate pH controlled ANODIZING!

Solve your troublesome anodizing problems once and for all by using BECKMAN pH Control—a "must" in anodizing aluminum by the sulfuric acid or chromic acid methods where careful pH ranges have to be maintained. By far the fastest, simplest—and in the long run—cheapest way to measure pH accurately is with Beckman Glass Electrode pH Meters. Because Beckman pH Equipment does the job better for less—because Beckman has been responsible for nearly all major advances in this field—you owe it to yourself to investigate how BECKMAN can untangle your production snarls and cut costs.

"Beckman pH Instrumentation is absolutely essential for close control in anodizing!", says Crown City Plating Company. For full details, see your Beckman Dealer, or write for Data File 62-72

GENERAL PURPOSE — Beckman Model H-2 pH Meter. A line operated "workhorse" designed for plug-in convenience on 115 v AC circuits and 24-hour duty. Permits instant measurements without turning on and adjusting instrument.

PORTABLE — Beckman Model N pH Meter. This compact, easily carried traveling laboratory contains everything you need for making pH measurements around your plant. Low price, light weight, battery-operated. Accuracy within 0.03 pH.

Beckman *division*

BECKMAN INSTRUMENTS, INC.
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Personals

the Bayonne laboratory. His work has centered on the development of new welding electrodes and has resulted in a number of patents and technical papers in this field. He is a member of the American Society for Metals, the American Welding Society, and the American Chemical Society.

Sellers is a M.S. graduate of Vanderbilt University. Formerly chief chemist with the Ethyl-Dow Chemical Company at Kure Beach, N. C., he joined the staff at the Bayonne Laboratory in 1944 as research chemist. Sellers's work has been chiefly in the electrodeposition of nickel and nickel alloys, in which field he has published several technical papers. He is a member of the American Electroplaters' Society and the Electrochemical Society.

William B. Bauzenberger has recently been appointed sales manager of Apex Alkali Products Company, Philadelphia.

Bill Bauzenberger has been with Apex since 1943. In 1949 he was appointed sales manager of western Pennsylvania, Ohio, and Indiana, with headquarters in Pittsburgh.

Bauzenberger

Bill's residence now will be in suburban Wayne, Pa., and in his new capacity he will function as sales manager for all territories for Apex.

R. B. (Bob) Grant has been appointed Los Angeles branch manager for Minneapolis-Honeywell Regulator Co. Since 1949 he has been regional industrial manager for the Pacific region.

Grant joined Honeywell 14 years ago after obtaining a master's degree in engineering at the University of Utah. He started as sales engineer in the company's industrial division in San Francisco, was transferred to Los Angeles as sales engineer in 1941, became Los Angeles branch industrial manager in 1946, and regional industrial manager in 1949.

S. J. Stowell has been named sales manager of Tranter Manufacturing, Inc., Lansing, Mich., it was announced by **James R. Tranter,** president. Stowell succeeds **J. R. Tepfer,** vice-president, who resigned July 31.

Stowell has been merchandise manager

Sel-Rex Bright Gold Process

has become

THE NEW "GOLD STANDARD"

- It requires no scratch brushing or buffing for a mirror bright finish.
- Its greater throwing power gives more protection with less gold.
- It gives 40% more resistance to wear and abrasion.
- Directly over steel, it gives six times greater protection with ¼ the amount of gold, in salt spray tests under standard ASTM conditions.
- It is twice as hard as conventional gold plating.
- It does not alter or deform surface contours because of smoothness of deposit.

Sel-Rex Bright Gold solution is easy to maintain, and operates at room temperature. No special equipment is required. Hundreds of successfully operating installations, both decorative and industrial, have proven the superiority of the new Sel-Rex Bright Gold Process.

SEL-REX PRECIOUS METALS, INC.

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PRECIOUS METALS SALTS AND SOLUTIONS FOR THE PLATING INDUSTRY

STORTSWELDING adds years of life

Your special duty tanks, like this rubber-lined salt spray testing chamber, will profit by the many years of experience that Storts has had in welding tanks for severe operating conditions. The Storts single standard of weld quality develops full strength of the base metal and assures more years of dependable and maintenance-free performance.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

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STOP Shooting in the Dark

to be sure— see Mutual

. . . and when you see the Mutual label on your Chromic Acid drums you can be sure of the highest purity obtainable . . . on every shipment. Yes, you can be *sure*, if it's

Mutual Chromic Acid

Sodium Bichromate

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Mutual Chromium Chemicals

MUTUAL CHEMICAL COMPANY OF AMERICA

99 PARK AVENUE • NEW YORK 16, N. Y.

Personals

of Tranter Manufacturing, Inc., since 1953, when he joined the organization after 14 months duty with the United States Navy as operations officer aboard a mine sweeper. Previously he was a district sales manager for the Lonergan Manufacturing Company and Refrigeration Corporation of America.

L. David Cook, formerly head materials engineer at Wyandotte Chemicals Corporation, has been named sales engineer for Bart Manufacturing Corporation.

Cook **Hennessey**

He will open a Detroit office for the organization and provide service for the associated companies: Bart-Messing Corporation and Sel-Rex Precious Metals, Inc.

Cook will be primarily concerned with development of markets in the Midwest for Bart Lectro-Clad nickel plated steel plates, seamless steel pipe, and fittings, which are used for corrosion and contamination control in the chemical, pulp and paper, and petroleum industries.

His broad experience in the corrosion control field includes work as a technical consultant on construction materials for major chemical equipment used in production processes. Cook's office will be located at 18050 James Couzins Highway, Detroit.

James H. Hennessey has joined the industrial sales and service staff of Wyandotte Chemicals Corporation. Hennessey, a graduate of Germantown Academy, has been a resident of Philadelphia for six years and was recently general manager of a firm specializing in industrial storage tank cleaning.

Following intensive training at Wyandotte Chemicals' industrial research and technical service laboratories, Hennessey will serve the metal working and metal finishing industries in the greater Philadelphia area.

Dr. Henry A. Goldsmith and **Ben Ray** have been appointed chief chemist and manager of technical field service, respectively, of Solventol Chemical Products, Inc., Detroit.

Howard B. Downs, vice-president and general manager, says these appointments are part of a continuing expansion program in the industrial division, made

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1418.

Before using ZORBALL, Academy Plating had to scrape tallow, grease and abrasive from their polishing-room floor. Even steam cleaning failed to budge deposits.

After using ZORBALL, Academy Plating once again has *clean, safe* floors. No scraping is required. All that's needed is to spread and sweep up ZORBALL daily.

ZORBALL ends floor scraping at Academy Plating Co.

"PREVIOUS to the use of ZORBALL on our polishing-room floor, we used scrapers to remove the buffing compounds consisting of tallow, grease and abrasive which had accumulated," reports Herbert Mancini, superintendent, Academy Plating Company, Newark, N.J.

"We also tried a steam-cleaning machine using an alkaline detergent, but it failed to remove these deposits. However, three weeks after applying ZORBALL, the unsightly and dangerous condition was cleaned up by the traction of the polishing operators' shoes on the floor. No labor was required except the daily spreading and removal of the ZORBALL!"

Removing compound deposits is just one of the big benefits you get from ZORBALL — the safest, lowest use-cost floor absorbent known. It absorbs oil, water, paint, chemicals, yet remains skidproof and nonflammable — even after hard use, or when saturated. Dried out, ZORBALL can be re-used without mudding, caking or dusting. Ask your Wyandotte representative or jobber for a sample or demonstration, today! *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California.*

Wyandotte CHEMICALS

Helpful service representatives in 138 cities in the United States and Canada

Largest manufacturers of specialized cleaning products for business and industry

Available for Immediate Shipment, Attractive Values

THE FOLLOWING EXCELLENT REBUILT AND GUARANTEED ELECTROPLATING MOTOR GENERATOR SETS AND RECTIFIERS, WITH FULL CONTROL EQUIPMENT:

PLATERS

1—7500/3750 AMPERE, 9/18 VOLT, **HANSON-VAN WINKLE-MUNNING,** Synchronous.
1—5000/2500 AMPERE, 9/18 VOLT, **COLUMBIA.**
1—5000/2500 AMPERE, 8/16 VOLT, **CHANDEYSSON,** 25° C., Exciter-in-head.
1—5000/2500 AMPERE, 6/12 VOLT, **CHANDEYSSON,** 25° C., Synchronous, Exciter-in-head.
1—4000/2000 AMPERE, 6/12 VOLT, **CHANDEYSSON,** 25° C., Exciter-in-head.
1—3000/1500 AMPERE, 6/12 VOLT, **COLUMBIA,** Synchronous.
1—2500/1250 AMPERE, 9/18 VOLT, **ELECTRIC PRODUCTS,** Synchronous, Exciter-in-head.
1—2000/1000 AMPERE, 8/16 VOLT, **ELECTRIC PRODUCTS.**
1—1500/750 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING,** Synchronous, Exciter-in-head.
1—1500/750 AMPERE, 12/24 VOLT, **CHANDEYSSON,** Synchronous, Exciter-in-head.
1—1000/500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS.**

ANODIZERS

1—4000 AMPERE, 40 VOLT, **CHANDEYSSON,** Exciter-in-head.
1—1000 AMPERE, 30 VOLT, **IDEAL,** Exciter-in-head.
1—1500 AMPERE, 40 VOLT, **HANSON-VAN WINKLE-MUNNING,** Exciter-in-Head.
1—1000 AMPERE, 40 VOLT, **CHANDEYSSON,** 25° C.
1—750 AMPERE, 60 VOLT, **HANSON-VAN WINKLE-MUNNING,** Synchronous, Exciter-in-head.
1—500 AMPERE, 25 VOLT, **CHANDEYSSON,** Synchronous, Exciter-in-head.
1—400 AMPERE, 40 VOLT, **M. G. C.,** Exciter-in-head.

RECTIFIERS

BRAND NEW BASIC RECTIFIERS, 1500/750 amperes, 6/12 volts. Special Price: $750.00 each. Separate Voltage Controls available.
1—2000/1000 AMPERE, 6/12 VOLT, **G. E.,** COPPER OXIDE, with Manual Control.
1—2000/1000 AMPERES 6/12 volt G. E., brand new selenium stacks, with "On-load" Automatic Voltage Regulator.
1—**GREEN SELECTOPLATER,** 1800 AMPERE, 12 VOLT, 220/3/60.
2—**UDYLITE-MALLORY,** 1500/750 AMPERE, 6/12 VOLT, Control.

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1—**RANSOHOFF** SPIRAL HOT AIR DRYER.
1—**CROWN** 18 x 18 CENTRIFUGAL DRYER, Steam Heat.
1—**STEVENS** SEMI-AUTOMATIC PLATING MACHINE, 30' long x 42" wide x 36" deep, rubber-lined tank, complete.
3—No. 1 and No. 2 **HARTFORD** TRIPLE-ACTION BURNISHING BARRELS, Lined and Unlined, Belted.
1—Production Pipe Polishing Machine, Model 101, Motorized.

Above is partial list only. Write to us for all your requirements for Plating, Anodizing and Metal Finishing

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Kirkland 7-5460 **CAMBRIDGE 38, MASS.**

Personals

necessary by the ever-increasing demand from the metal working industry for Solventol Di-Phase metal cleaners and cleaning equipment.

Goldsmith, as head of the research laboratory, will be responsible for product development and research. In addition, he will assist the technical sales and service division. He was educated in Europe at the University of Berlin and the University of Genoa, where he received his degree. Before joining Solventol, he was associated with several Eastern firms, among them Colgate Palmolive and Theobald Industries.

Ray brings to his new position several years experience with the Solventol Company and prior to that with Chrysler Corporation, where he worked on the surface treatment of metals in the metallurgical and processing laboratories.

Cooper M. Schley has joined the sales organization of the Pennsylvania Salt Manufacturing Company. With headquarters in Birmingham, he will represent the metal processing and maintenance

Schley

chemicals departments in the company's southern territory. He will handle Pennsalt's Fosbond-Foscoat products for the metal working industries and a diversified line of metal cleaners and maintenance chemicals serving the transportation and manufacturing fields.

Arthur F. Liska has been appointed controller of the George L. Nankervis Company, Detroit, engineers and manufacturers of electroplating facilities and industrial testing equipment.

Liska, a native Detroiter, enjoys a background of many years of experience in financial management. Prior to joining Nankervis, he was controller of the Burroughs Corporation.

C. J. Washing, Bridgeport, Conn., has been appointed sales engineer for the Wiretex Manufacturing Company, in the territory covering Connecticut, Rhode Island, New Jersey, Delaware, and Maryland. He will handle the complete Wiretex line of baskets, retorts, muffles, grids, screens, and racks for the plating and heat treating industry.

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Tumbling Abrasive

Various stamped, die cast, forged and screw machine parts before and after barrel finishing with EXOLON abrasives.

• More and more manufacturers are turning to barrel finishing for its big savings and uniformity over individual hand finishing.

Naturally, the process is only as effective as the abrasive used. In response to the demand for a fast-cutting, long-life abrasive, EXOLON has developed this superhard aluminum oxide grain which is *barrel-finished itself* for non-scratch, precision smoothing of your metal surfaces.

May we barrel-finish some of your sample parts *at no obligation to you?* Or, if you prefer, we are prepared to furnish you trial lots of Exolon Barrel Finishing Abrasive at quantity discount for trial in your own barrel. You will find, as others are finding daily, that it gives you a superior finish at substantially lower cost. Write today!

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- ★ IN CLEANING UP
- ★ IN REMOVING BURRS
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Facts...

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Semi-automatic and full automatic plating machines justify their cost, usually in a surprisingly short time, by savings in man power, floor space, and by eliminating the cause of many undesirable conditions in the plating room. Meaker machines fulfill the most exacting requirements and have demonstrated their extremely low maintenance cost over the years.

Meaker machines are designed for maximum flexibility, lending themselves to changes in product and processing techniques. A simple and positive adjustment provides for variations in production or plating specifications.

For the occasional job where a special and complicated treatment is needed requiring an intricate handling function, which even a unit as flexible as the Meaker machines cannot provide, our engineers, drawing on more than fifty years' experience in this field, will carefully analyze the problem and design equipment to satisfactorily accomplish the desired results.

Write for your free brochure of Meaker Equipment for plating, anodizing, pickling, bonderizing, and other processing. Contains numerous illustrations of plating machine installations, construction features, application information and operating tables.

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- Full Automatic and Semi-Automatic Plating Machines
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- Batch Type Plating Machines
- Pickling Machines
- Processing Conveyors
- Motor Generators for Plating
- Rectifiers for Plating

Trade Literature

L—1100. Transfer Unit Processes Racked Parts Automatically—More uniform results and tremendous labor saving in processing of metal parts for plating, painting, paint dipping, and etching is afforded by an improved automatic transfer unit developed by Belke Manufacturing Company.

The automatic transfer unit consists of a series of tanks equipped with transfer machine which automatically lifts and moves the racked parts progressively from tank to tank at a preset timing interval. In each transfer, parts are exposed to the air only 14 seconds.

Units can be supplied with practically any number of tanks. A commonly used cycle is electrocleaning, tepid running rinse, anodic electroclean, cold running rinse, acid bath, cold running rinse, cyanide bath, and cold running rinse. Practically any cycle can be had.

The machine can be arranged to skip tanks, which permits processing articles of different metals such as steel, brass, and die castings without changing solutions.

Automatic timing assures uniform processing time and permits the operator to devote full attention to loading and unloading. The time control is adjustable for processing intervals from 10 seconds to 20 minutes. For literature, use Reader Service Card.

L—1101. Revises Catalogue on Pressure Filters—Industrial Filter and Pump Manufacturing Company has issued a revised eight-page catalogue on their line of vertical leaf pressure filters used for solution clarification. This catalogue gives detail description of the design and construction of industrial filters and illustrations of the different standard models. Sizes and capacity specifications for all standard sizes are included. For your copy, use Reader Service Card.

L—1102. Vacuum Metalizing Described in Brochure—Vacuum metalizing—the depositing of a thin coating of metal by evaporation and condensation under high vacuum conditions—is a clean, low-cost production technique which is rapidly supplanting other metal-finishing processes on a wide variety of products. Without buffing or polishing, it gives a bright, lustrous, metallic finish—which may be either decorative or functional—on any base material: plastic, metal, glass, paper, or textiles.

The process is fully described and many of its applications are illustrated in a new brochure, "Vacuum Metalizing,"

which has just been issued by F. J. Stokes Machine Company. The brochure itself is a specimen of the silver-bright finish obtained by this process: its cover is a sheet of acetate which has been vacuum metalized with a coating of aluminum 3 millionths of an inch thick before being bonded to the paper stock.

Copies of the brochure, Catalog No. 780, may be obtained free on request by using Reader Service Card.

L—1103. New Alkaline Rust Remover—Enthone, Inc., has announced the development of a new nonelectrolytic alkaline derusting compound. The product, known as Alka-Deox 114, is stated to be a free-flowing powder that is used in a concentration from 1 to 3 lb/gal of water. When a solution of the salts is heated to from 180° F to the boiling point, rapid removal of rust is accomplished.

Due to its alkaline nature, there is no attack upon the base steel leaving it clean and bright. Because of its high alkalinity, paints, organic coatings, and other surface contaminants are removed together with rust. Due to the lack of necessity to use electric current, the product is stated to be ideal for bulk derusting of steel and cast and malleable iron.

A technical bulletin describing Alka-Deox 114 and its uses will be sent on request by using Reader Service Card.

L—1104. Worklon's Newest Catalog on Orlon and Dynel Clothes—Savings are the salient feature of a newly published catalog issued by Worklon, Inc., makers of acid- and caustic-resistant industrial apparel. Substantial reductions are indicated on most garments.

The Worklon line includes a complete selection of men's clothes in both miracle fabrics—DuPont's Orlon and Union Carbides's Dynel. Impartial reports from the Bureau of Ships of the United States Navy reveal that industrial apparel manufactured of Orlon and Dynel actually last 50 times longer than cotton or wool under acid conditions. The Worklon catalog includes a detailed report of these findings along with documented data on the technical properties of Orlon and Dynel under all manner of chemical conditions.

Get your copy of this catalog by using Reader Service Card.

L—1105. Blastmaster Rotoblast Bulletin—Pangborn Corporation, Hagerstown, Md., manufacturer of blast cleaning and dust control equipment, has issued a newly revised Blastmaster Rotoblast bulletin that includes information on the full line of sizes. Bulletin No. 225 carries complete specifications and dimensions for all Blastmaster barrels from the 1½ cu ft to the 27 cu ft size.

In addition to illustrating the various features of this high-production-rate blast

Safe, easy to handle

● Koppers Potassium and Barium Cyanide Solutions eliminate the dissolving step in your plating operation. The solutions are delivered to you, ready for the plating bath. Time-consuming preparation is out—no dangerous cyanide granules to handle, no drum cleaning, and no need to expose working personnel to cyanide powder dust.

POTASSIUM CYANIDE, 35-40%
widely employed in high speed copper electroplating on steel when copper is used as a base coat for nickel and chromium. Forms soluble complexes with copper, silver, gold, cadmium, zinc, and other metals of the general form $K_2M(CN)_4$.

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useful in cyanide plating, particularly in gold, silver, zinc and cadmium plating to remove the troublesome effect of carbonates and sulfates in the bath. Increases the cyanide content of the bath without adding extraneous materials.

Koppers Cyanide Solutions can be delivered to you by tank truck, and pumped directly from the truck into your storage tank—ready for immediate use. They are also available in 55-gallon drums from which the final traces of solution can easily be removed by water wash.

In addition to the Cyanide Solutions, Koppers produces many other synthetic chemicals, including Resorcinol, Styrene Monomer, Polystyrene, Phthalic Anhydride, Divinylbenzene, and Di-tert-butyl-para-cresol. For further information on any of these chemicals, write:

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machine, the bulletin shows how production savings may be realized by using the Blastmaster—designed specifically for newer abrasives—for batch blast cleaning of castings, forgings, and heat treated parts.

Bulletin No. 225 may be obtained by using the Reader Service Card.

L—1106. Finishing Oven Brochure—A new eight-page brochure on finishing systems for baking and drying all types of industrial equipment is offered by the Michigan Oven Company, Detroit.

The brochure outlines the features to look for when purchasing a finishing oven and includes six case histories showing how various manufacturers solved their finishing problems effectively. Additional information is included that will be of value to anyone contemplating the purchase of a finishing oven now or at a later date.

The brochure may be obtained by using the Reader Service Card.

L—1107. Power Spray Washers Bulletin—Peters-Dalton, Inc., Detroit, has just published a new 16-page brochure (Technical Bulletin No. 301) entitled "Power Spray Washers." This two-color, profusely illustrated booklet groups and discusses in a clear and comprehensive manner all types of power spray washers and their layouts and applications. Fifteen engineering drawings, incorporating only the essential features of a number of the most commonly used types of washers, are included.

For your copy, use Reader Service Card.

L—1108. Diffusion Pumps Catalogue—A new catalogue describing its complete line of diffusion pumps is available from Naresco Equipment Corporation, equipment sales subsidiary of National Research Corporation.

This catalogue gives the characteristics of each pump, including pumping speeds, operating pressures, blank-off pressures, and forepressure limits.

Operating charts on throughput and inlet pressures, as well as photographs and drawings, are included in the catalogue.

Copies of this new diffusion pump catalogue may be obtained by using the Reader Service Card.

L—1109. Alodizing Bulletin Available—A four-page bulletin describing the American Chemical Paint Company's "Alodine" No. 1200 is now available. "Alodine" No. 1200 is a simple, effective, and economical treatment for the protection and paint-bonding of aluminum.

For your copy, use Reader Service Card.

L—1110. Wet-Blast Machine Catalogue—Literature describing the new, low-cost wet-blast unit that can be operated in conjunction with a 3-HP air compressor is available from the Cro-Plate Company, Inc., manufacturers of the pressure blast line of wet-blast machines. The catalogue fully explains the various design and operational features of the unit, along with application data and before-and-after photographs.

To get your copy, use Reader Service Card.

L—1111. Safety Clothing Booklet—Pulmosan Safety Equipment Corporation's new clothing booklet, describing their full line of asbestos gloves and mittens, chrome leather clothing, and Pulmotek (vinyl) clothing is now available upon request by using Reader Service Card.

L—1112. Paints for Metalworking Plants—Maintenance engineers in metalworking plants will find the new Flexrock catalogue, "Paints for Metalworking Plants," to be of value.

A complete line of metalworking maintenance paints in ten categories, with where-and-how-to-use outlines, makes this book a reference guide for plant superintendents, engineers, and production managers.

Many paints especially suited for application in metalworking plants, including fume resisting paints, non-yellowing whites, and acid resistant floor finishes, are described with details as to coverage, solvents, spraying, and brushing. Special attention has been given to making the index concise and clear for easy reference by the busy engineer.

For more information and a copy of "Paints for Metalworking Plants," use Reader Service Card.

Nice Product, Nice Package

Folks often wonder why we spend an extra ¼¢ a pound out of our own pockets for a lithographed drum. Fact is we're proud of the quality of BFC Chromic Acid and figure it deserves a bright, colorful container.

Every batch gets checked against a tough quality spec. Off-grade acid goes on the dump. Only top-quality material goes into those shiny BFC drums. Send us a modest order and see for yourself.

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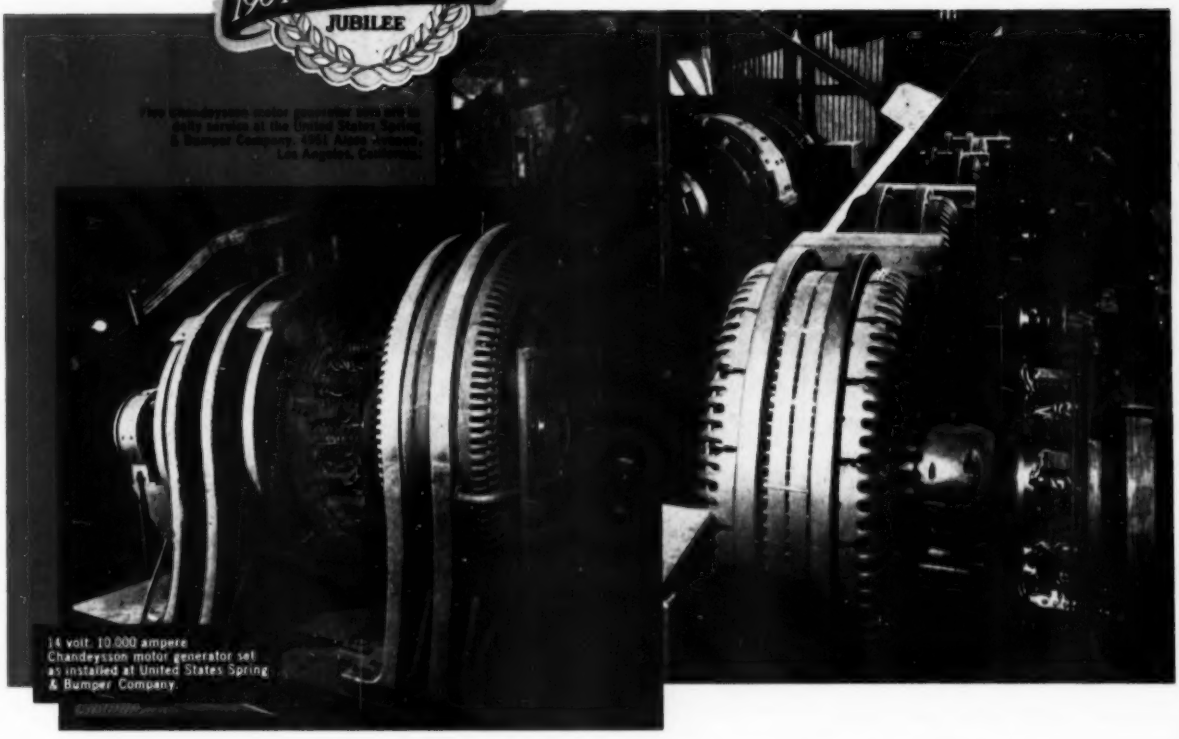
Chandeysson

GOLDEN JUBILEE 1904 1954

CUTS COSTS OF POWER CONVERSION



14 volt, 10,000 ampere Chandeysson motor generator set as installed at United States Spring & Bumper Company.

IN 23 YEARS "WE HAVE SPENT PRACTICALLY NOTHING FOR MAINTENANCE AND REPAIRS" Says

UNITED STATES SPRING & BUMPER CO., Los Angeles, California

"And," continues Mr. John B. Rauen, President of United States Spring and Bumper Company, "we are still using the first Chandeysson generator we ever bought . . . even though we have given it pretty rough treatment at times. We have 5 Chandeysson generators now, all giving dependable service although we overload them quite heavily at times."

So says another long-satisfied Chandeysson owner . . . proof once again that any way you look at it, any way you figure it, "Chandeysson cuts costs of power conversion." You can expect similar performance from a Chandeysson installation in your plant.

Write, or mail coupon, for full information.

CONVERT WITH *Chandeysson* AND SAVE 4 WAYS

- **Use less power**
- **Get more out of the power you pay for**
- **Be sure of power when you need it most**
- **Enjoy lifetime power dividends**

Bulletin D-102 contains data and specifications on Chandeysson machines. Your copy sent promptly, and without obligation.

The fine results of an improved commercial policy, a new merchandising program, and improved manufacturing facilities make it possible for Chandeysson Electric Company to engage additional and supplemental distributors in certain parts of the country. If you are a qualified manufacturer's representative, we shall be glad to hear from you.

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4078 Bingham Avenue, St. Louis 16, Missouri

Please send me a copy of Bulletin D-102.

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Yes, Auromet has Bright Gold but don't overlook the ordinary gold bath first. Why pay a premium for gold when perhaps it is not needed. Let an Auromet technical representative give you the facts about both types of gold baths. Add the King Midas touch the Auromet way. Auromet Corporation also manufactures Gold Solutions, Silver, Silver Cyanide and Nitrate, Platinum, Palladium and Rhodium Concentrates. For complete information and technical service call WOrth 6-0863 collect.

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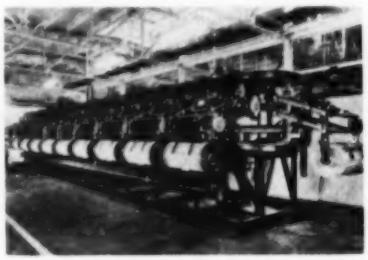
Equipment and Supplies

E—1113. Phosphate Coating on Zinc—Availability of Fosbond 61, a new product for use in producing a phosphate coating on zinc, has been announced by the Pennsylvania Salt Manufacturing Co.

This phosphatizing compound provides a fine crystalline coating on metal surfaces which serves as an excellent base for subsequent painting operations. Mixed with water, it is applied by spraying. For more information, use Reader Service Card.

E—1114. Automatic Plating Barrel Conveyor—A new conveyor, announced by the Udylite Corporation, Detroit, is of the return type using the standard Udylite horizontal barrel plating cylinder.

Illustrated is a heavy duty, high production plating machine. The chassis is



rigidly constructed, using a maximum fiber stress of 10,000 psi. Highest quality materials are used throughout, such as Baldwin Duckworth roller chain, General Electric motors and plugging switches, Cleveland Worm Gear speed reducers, Morse Chain torque limiting clutches, Chrysler Oilite bushings and self-aligning bearings, and Allen Bradley limit switches.

The machine is remarkably flexible because of timer controlled speed and power operated skip transfers. The rpm of the cylinder can be changed; as an example, cylinders in cleaning and plating can operate at one speed, and cylinders in dichromating and subsequent tanks can operate at a much lower speed. All cylinders are potentially capable of individual lowering or raising.

The cylinders revolve in a trough of anodes in the plating tank, the anodes being on both sides of the cylinders. With the conforming anode containers, the solution resistance is held at a minimum.

The machine is engineered so that none of the operating mechanism is over the tanks except vee-belt drives, which will not rust. The cylinders rotate when raising and lowering, thus greatly reducing drag-out losses and solution contamination—it

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IF YOU ARE OVER 45 and your wife keeps insisting that you should have *two* chest x-rays every year... don't blame her. *Thank* her! Semi-annual chest x-rays are the best "insurance" you can have against death from lung cancer.

The cold fact is that lung cancer has increased so alarmingly that today you are six times more likely to develop lung cancer than a man of your age 20 years ago. Our doctors know that their chances of saving your life could be as much as ten times greater if they could only detect lung cancer before it "talks"... before you notice any symptom in yourself. That's why we urge you to make semi-annual chest x-rays a habit—for *life*.

To see our new life-saving film "The Warning Shadow" call the American Cancer Society office nearest you or simply write to "Cancer" in care of your local Post Office.

American Cancer Society

SPECIAL

Introductory Offer!

Why deny your plant the many advantages of the latest ROHCO® Test Equipment? To introduce these benefits to you—a special "package offer" of a NEW CHEMICAL Porcelain HULL CELL, currently sold separately at $14.50, will be given FREE with the purchase of either a ROHCO Comet Rectifier or a B-1000 Rectifier. This special offer can only be given to all orders received on or before December 31, 1954!

ACT NOW!

THE NEW CHEMICAL Porcelain HULL CELL

Far superior to other types. Put directly on hot plate—marvelous for chrome, nickel and other plating baths operated hot. Same highest quality as chemical porcelain crucibles and other analytical equipment. Available in 267 ml size. Price . . . $14.50

EVERY Plating Shop Needs the New ROHCO COMET RECTIFIER

The ROHCO COMET RECTIFIER has many new features heretofore unavailable, including the dual-range ammeter for accurate reading from 0 to 30 amperes. For Hull Cell tests—use the 6 ampere, 18 volt range; for small plating operations or experiment—use the 30 ampere, 13 volt range.

Specifications

Input: 110 volts, 60 cycles A. C. Single phase.

Output: 0 to 6 amps. at 0 to 18 volts; 0 to 30 amps. at 0–13 volts. Filtered output for minimum ripple. Heavy duty rectifiers for continuous operation.

Ammeter: Dual range, 0 to 6, 0 to 30 amps.

Voltmeter: Single range, 0 to 20 volts.

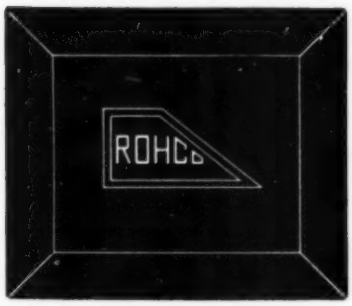
Stepless voltage control: 0 to full load.

Timer: Synchronous timer up to 5 minutes, 60 minutes, or 3 hours as specified, can be switched in or out of circuit, cuts off current automatically and simultaneously gives audible signal.

Two fused convenience outlets for 110 volt accessories.

Price: Comet Rectifier—$190.00 F. O. B. Rocky River, Ohio.
B-1000 Rectifier—$160.00, F.O.B. Rocky River, Ohio.

Same as Comet except without built-in timer or outlets



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Equipment and Supplies

is a well-known fact that cylinder perforations are filled with the last solution in which the cylinder was immersed.

The machine is electrically and mechanically operated—it could be left in the up position indefinitely. This means that the cylinders may be left in the elevated position (over hot tanks) overnight or during a weekend.

For further details, use Reader Service Card.

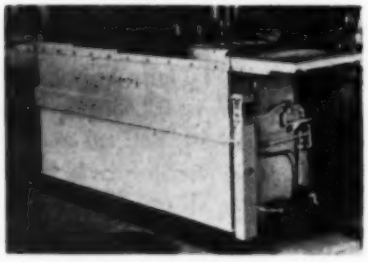
E—1115. Improved Barrel Nickel Plating Process Gives Fully Bright Deposits—An improved nickel plating process for barrel electroplating, announced by Hanson-Van Winkle-Munning Company, produces fully bright ductile white deposits that have low stress.

The process, which has recently undergone extensive commercial testing, is also characterized by stability of plating solution over long periods and deposits that require no activation prior to chromium plating.

Called Nickel-Lume Barrel Plating, the new process is the adaption of H-VW-M's new standard Nickel-Lume nickel bath to barrel electroplating. Typical products handled include small automotive parts, jewelry, novelties, toilet articles, hardware, fasteners, and screws.

For further information, use Reader Service Card.

E—1116. Circo Reduces Degreaser Costs with Bart Lectro-Clad Steel—Complete fabrication of industrial degreasing equipment with nickel clad steel, at



no greater cost than equipment fabricated with other less effective clad materials, is now being accomplished by Circo Equipment Company through the use of the new Bart Lectro-Clad nickel plated steel.

Considerable savings in material costs, as much as 30 per cent over minimum nickel clad steel produced by conventional rolling methods, result from the tailored thicknesses of nickel which can be deposited on the steel. The Bart Lectro-Clad steel, manufactured by Bart Manufacturing Corporation, of Belleville, N. J., makes available for the first time deposits of nickel ranging from 0.007 to 0.020-inch thick regardless of the thickness of the steel. Previously, nickel clad steel below ½ inch in thickness was not available with less than 10 per cent cladding.

The electrodeposited nickel, tailored to particular applications, offers excellent corrosion protection and is being used in all models of Circo degreasers, including the highly successful Circo ultrasonic degreaser, whenever a nickel clad unit is specified by the customer.

In addition to its usefulness for fabricating degreasing equipment, Bart Lectro-Clad is finding increasing application for fabrication of various types of corrosion resistant equipment with the thickness of clad being determined by corrosive and erosive factors. The thin deposits are excellent for contamination control. Because of the savings in material costs that can be effected with Bart Lectro-Clad steel, it is gaining wide acceptance in upgrading equipment where the protective qualities of nickel are highly undesirable, but where in the past the cost of nickel cladding has been prohibitive.

E—1117. New Metals Broaden Platecoil Potential—Use of new metals in the construction of Platecoil, a heat transfer unit, is broadening the application of this product that has proved efficient in many industrial processes in the half-dozen years it has been on the market.

Guaranteed
FRAY-PROOF
Performance!
with JOE-D — the Original
Bias Sisal Buffs
Because they're cut on the bias, JOE-D Bias Sisal Buffs give actual *fray-proof* performance. No loose ends to whip or scratch . . . always an even nap to hold compound and provide better color. Made of only the finest imported Sisal, specially treated to eliminate brittleness and run *clean*. For high-quality, high-volume production, insist on *genuine* JOE-D Bias Sisal Buffs!
Available with steel or fibreboard centers. Also complete selection of Conventional and Bias Spoke (Finger) Sisal Buffs.
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A few choice territories still open — WRITE TODAY!
JOE-D
Buff Company

Come up with bright zinc deposits—*every time*

with Du Pont Plating Chemicals

"ZIN-O-LYTE"*

(ZINC PLATING CHEMICALS)

For brilliant zinc plating —without bright dipping!

Check these outstanding features:

- Blue-white, rust-resistant deposits—over a wide range of current density—obtained *directly* from bath!
- No bright dipping—saves time and labor.
- Prepared salts—baths are easier to make up and economical to maintain.
- Particularly effective for barrel plating.
- Work of all shapes and sizes and most ferrous metals can be efficiently zinc-plated.

*REG. TRADE-MARK

"DUROBRITE"*

(ADDITION AGENT 309)

For bright zinc plating —at a very low cost!

Check these outstanding features:

- Extremely economical—small amounts produce bright, lustrous plate.
- Pure, uniform deposits are perfect for subsequent bright dipping, passivating and conversion coatings.
- Cuts production costs in all types of equipment . . . still, barrel or automatic units.
- Improves covering power by extending the bright plating range to low current density areas.

*REG. TRADE-MARK

Your Du Pont representative will be glad to help you select the plating chemicals best suited to your operation. Call him or contact any one of the district offices listed below.

DISTRICT OFFICES: *BARADA & PAGE, INC.

Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit • El Monte (Calif.) • Kansas City* • New York • Philadelphia • Export Division, Wilmington, Del.

Chemicals • Processes • Service

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DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING

. . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Dept., P-11, Wilmington 98, Del.

Please send me more information on Du Pont Plating Chemicals —properties, advantages and recommended procedures. I am interested in the following types of plating:

☐ Cadmium Plating ☐ Tin Plating
☐ Zinc Plating ☐ Copper Plating

*Name*_____

*Firm*_____

*Street & No.*_____

*City*_____ *State*_____

Equipment and Supplies

Experiments at Tranter Manufacturing, Inc., of Lansing, Mich., makers of Platecoil, prove the unit can be made of Ampco alloy, Carpenter 20 alloy, Hastelloy B, and Hastelloy C.

Previously made of cold rolled steel, stainless steel, and monel Platecoils have found a wide application in heating solutions for plating, rinsing, washing, and many other processes.

Use of the new metals means the units can be made resistant to a much wider range of corrosive media. In fact, tests indicate the whole range of materials can provide Platecoils resistant to more than 200 different corrosive media.

For further details, use Reader Service Card.

E—1118. New Line of Rectifiers—The Walker Division of the Norma-Hoffmann Bearings Corporation announces a line of selenium and other dry disc rectifiers to meet every requirement of the electroplater.

Closely regulated power supplies having low or high-ripple content dependent on plating requirements are available. Special designs to meet customer requirements are common. Low temperature rise equipment operating in high ambients without harmful effects to life and dependability are built into the equipment as is overload capacity. Information is available by using Reader Service Card.

E—1119. Additions to Pennsalt's Line Reduce Metal Processing Costs—The Fosbond line of the Pennsylvania Salt Manufacturing Company now includes all chemicals necessary to apply iron or zinc phosphate coatings to steel or zinc surfaces for improved paint adhesion. Used in all fields where metals are painted, Fosbond provides durable coatings through fast, trouble-free processing operations on surfaces previously considered uneconomical to coat because of the time factor involved. Its use in less difficult coating operations speeds the process and reduces production costs.

For further information, use Reader Service Card.

E—1120. Vacuum Metalizer Meets Moderate Requirements—A new and compact "package" vacuum metalizer, designed to meet the needs of firms with moderate production requirements, such

as jewelry manufacturers, custom plastics molders, custom metal finishing plants, and other manufacturers who wish to do their own finishing but have a relatively small volume of work, has just been introduced by the F. J. Stokes Machine Co., Philadelphia.

The new Model 428 metalizer has a chamber 36 inches in diameter and to inches long, giving it two-thirds the cubic capacity of the popular Stokes 48-inch Model 426. The 428 is a simplified unit, stripped of some of the more elaborate automatic features of the larger Stokes metalizers, and is intended to bring vacuum metalizing economically within the reach of firms whose present volume would not justify the larger units.

For further details, use Reader Service Card.

E—1121. New Wide Range Hook-On Volt-Ammeter—A new wide range pocket size volt-ammeter for measuring alternating current and voltage quickly and accurately has been introduced by the General Electric Company's Instrument Department.

Measuring only 9 1/8 x 3 7/16 x 1 9/16 inches, the new product is designated AK-4, and includes 150/300/750 volts AC as its volt ranges.

Capable of measuring current on both insulated and noninsulated conductors without cutting the conductor or interrupting work, the new volt-ammeter is equipped with scales that automatically change when the range selector knob is turned, thus reducing the possibility of reading a wrong scale.

GRIND
POLISH
BUFF
DEBURR

with a Hammond ROTARY AUTOMATIC

Model "K" Hammond Automatic Finishing Machines are made in 34", 46" and 62" table sizes. These models are either continuous or for indexing at 150 to 1700 indexes per hour. Head styles include floating, non-floating with 3 H.P. to 20 H.P. range. Also available are attachments for converting heads from buffing to abrasive belt polishing. The Hammond Model "K" will speed up your grinding, polishing, buffing, brushing and de-burring operations. Send us samples and learn how much you can speed them up.

SEND SAMPLES and we'll show you how much you can speed production and cut costs.

Hammond Machinery Builders INC

1613 DOUGLAS AVENUE KALAMAZOO, MICHIGAN

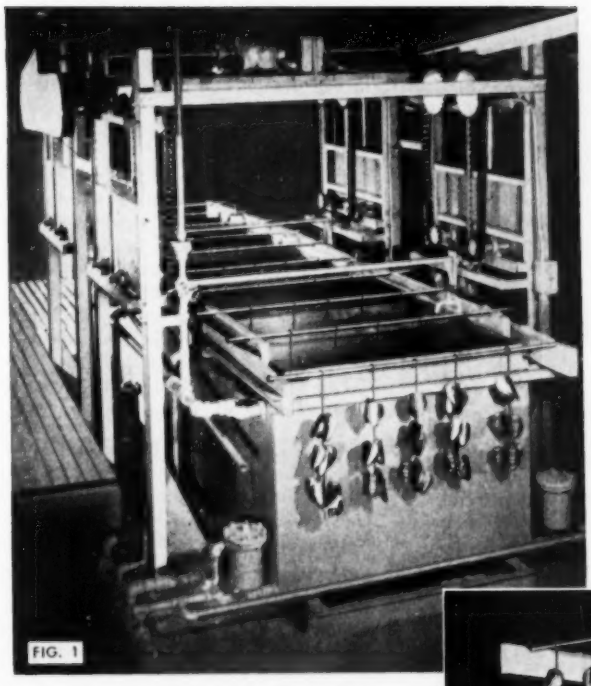


FIG. 1

NEW Automatic TRANSFER MACHINE for Pre-Plate Processing

One unit saves labor of 3 to 6 men.

Extremely flexible—different metals such as steel, brass and even die casting can be processed with the same set-up.

Shops that have BELKE Automatic Transfer Machines use them for most of their work.

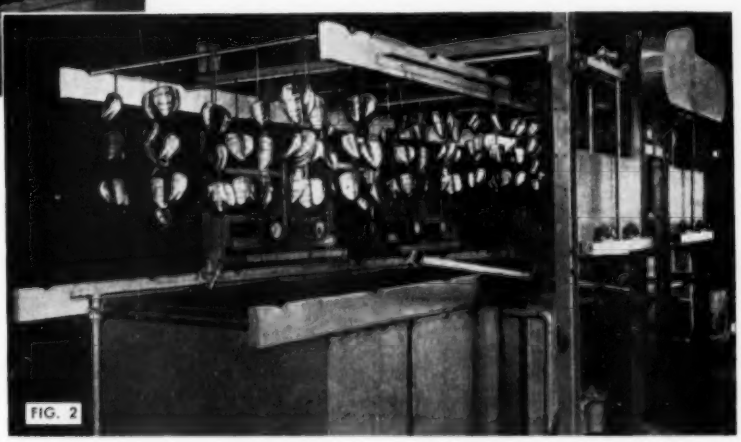


FIG. 2

Fig. 1. Loading End. Loaded racks are hung on rod placed in saddles on transfer frame. At end of each processing period the machine automatically lifts all rods and advances each one tank in the processing cycle.

Fig. 2. Delivery End. Picture shows transfer frame elevated in the transfer operation. When the frame comes down the last rod, which carries parts from the last tank in the processing cycle, will be placed in the unloading saddles on the frame which extends beyond the last tank.

Features

- Affords practically any required cycle for plating, painting, etching, etc.
- Flexible. Easily adjusted to "skip" tanks for processing articles of different basic metals without changing solution.
- Automatic Timing. Easily set for any processing period from 10 seconds to 20 minutes.
- Uniform Processing. The automatic timer doesn't forget — is not called away. Spoilage is avoided.
- Helps Foreman maintain full production. At a glance he can see partially loaded rods or empty saddles—then locate the cause.
- Available with conveyor-equipped plating tank to which processed work is automatically transferred.

The BELKE Automatic Transfer Machine stops the backaches and high labor costs of processing parts for plating.

The machine automatically lifts and transfers work from tank to tank through the entire pre-plating cycle such as electrocleaning, tepid running rinse, anodic electroclean, cold running rinse, acid bath, cold running rinse, cyanide bath, cold running rinse. Practically any cycle can be had.

The Transfer Unit can be adjusted to "skip" tanks as desired for processing articles of different metals such as steel, brass and die castings. This flexibility makes practical automatic processing of a great range of varied work.

For further labor-saving, a conveyor-equipped plating tank can be furnished with the BELKE Transfer Unit. The Transfer Unit automatically transfers processed work to the conveyor and the work is completely plated while moving through the plating tank.

Send for literature or see your BELKE Service Engineer.

Belke Manufacturing Company, 947 N. Cicero Ave., Chicago 51, Ill.

EVERYTHING FOR PLATING PLANTS

Equipment and Supplies

Uses of the AK-4 include checking circuits, motor overloads, and determining motor starting and running currents. Ideal for maintenance personnel, electricians, and contractors, the device quickly diagnoses trouble without the need of shutting down equipment.

For further information, use Reader Service Card.

E—1122. Solenoid Valves—Key to Many Automation Problems in Metalworking—Precise control of fluid flow is essential if modern metalworking machinery and equipment is to do its job properly.

As more and more companies turn to partial or full automation to speed production and lower costs, the need for newer and more efficient control devices becomes increasingly important. This is particularly true in the selection of solenoid valves for controlling automatic machine operations.

Metalworking firms are finding many uses for the "DO" (diaphragm operated) solenoid valve manufactured by Eclipse Fuel Engineering Company, Rockford, Ill., on machine tools, foundry machinery, and finishing and heat treating equipment. In particular, these valves are used for operations such as indexing, feeding, holding, speed changing, fixing, clamping, automatic cycling, and cutting oil and lubrication control.

For further information, use Reader Service Card.

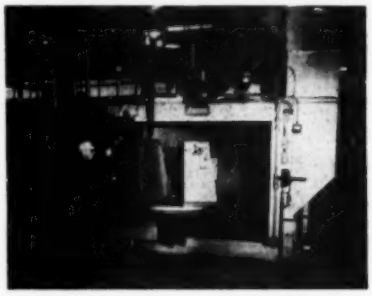
E—1123. New Plater's Putty—The Anderson's Plastics Company, Natick, Mass., has developed a superior plater's putty for use by the plating industry.

Plater's putty formula No. 5 is an excellent stop-off for threaded holes and other cavities. It can be used to cover or cap nuts and screws and is useful as a rack coating. It is particularly useful in hard chrome plating as it is resistant to chromic acid.

Plater's putty formula No. 5 does not dry or harden, even when left in an open can. It can be applied in two ways. If left in a cavity without heating, it can easily be punched out after use. If baked to 300 degrees for 15 to 20 minutes it will become flexible and rubbery. The plug can be reused. Plater's putty formula No. 5 can easily be removed with naphtha.

For further information, use Reader Service Card.

E—1124. Table-Type Blast Cleaner—A new kind of table-type airless blasting machine for various cleaning and peening applications is announced by American Wheelabrator & Equipment Corporation.



The machine, called a 72-inch Wheelabrator Swing Table, is distinct from other swing-table-type airless blasting machines in that it requires no pit at all for the abrasive hopper, whereas other types in the past have required them. The whole machine is built for floor level installation.

For further information, use Reader Service Card.

E—1125. Unusual Thermostat in New Regulators—Temperature regulators containing a new-type thermal element have been developed for use on internal combustion engines and other temperature control applications by the Fulton Sylphon Division of Robertshaw-Fulton Controls Company. The new regulators are supplied with three-way valves.

Changing over from the conventional liquid or gas-filled thermal element, the new regulators (Nos. 1280 and 1281) contain an unusual power-pill unit, which is charged with a solid, waxlike compound. When subjected to heat, the special waxlike compound imprisoned in the power-pill unit melts and expands, generating an extremely powerful force by comparison with older thermostatic units. The heated liquid returns to a solid state upon cooling.

Because they employ the power-pill units, the new regulators are insensitive to internal pressures of the system in which they are installed, an important performance factor where systems are

Now... get more for your anode dollar!

NEW ANACONDA "PLUS-4" ANODES*

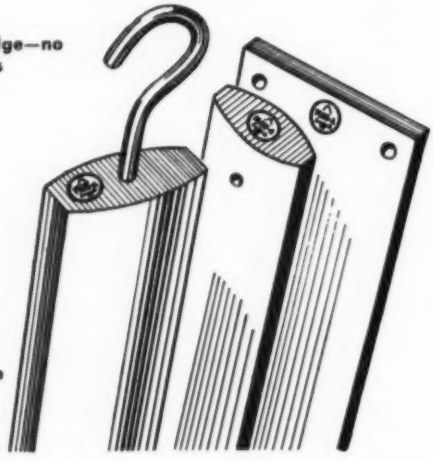
(PHOSPHORIZED COPPER)

+1 Freedom from anode sludge—no "bagging" or diaphragms required.

+2 No copper build-up in solution.

+3 Exceptionally smooth, heavy cathode deposits.

+4 10% to 15% more cathode deposits per pound of anode.



It has been discovered that carefully controlled amounts of phosphorus, together with minute amounts of other elements in electrolytic copper, make anodes of vastly superior quality for acid plating. ANACONDA "PLUS-4" Anodes are available in all the standard sizes and forms at no increase in cost over ordinary anodes. Look for the stamp "PLUS-4" on the anodes you buy.

We'll be glad to supply additional information, in detail, without obligation. Just write to: The American Brass Company, Waterbury 20, Conn.

*For use under Patent No. 2,689,216 54160

ANACONDA® "PLUS-4" ANODES made by THE AMERICAN BRASS COMPANY

Crown has the answer to the demand for...

"AUTOMATION"

THE MAGNETIC AMPLIFIER AUTOMATIC PROGRAMMED RECTIFIER

If you (like many other operators) have been considering Automation as a solution to every increasing production cost then here is the rectifier for you. The Crown magnetic amplifier controlled rectifier with automatic programming, engineered for trouble-free perfomance, ruggedly built for extra long life, provides...

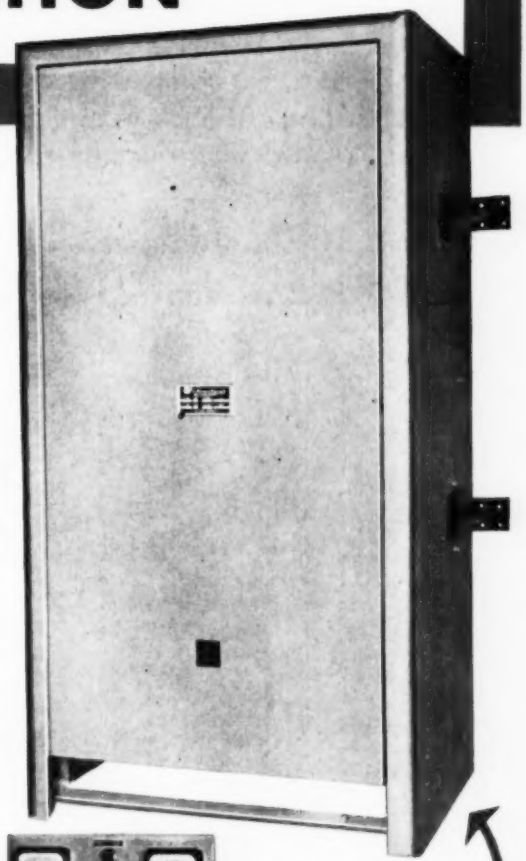
AUTOMATIC REGULATION OF EITHER D.C. VOLTAGE OR D.C. CURRENT OUTPUT

...in stepless adjustment throughout the voltage or current range, maintains voltage* or current at the desired values regardless of varying tank loads or varying tank conditions, automatically compensates for fluctuations in A.C. line voltage.

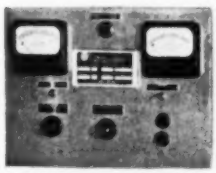
*Has upper current limiting circuit in the voltage stabilization cycle that will prohibit the use of the rectifier in excess of its rated voltage output.

PUSH BUTTON AUTOMATIC CYCLING OF FINISHING OPERATIONS

Complete set of programming controls will cut rectifier in at a given time, raise or lower the voltage to any preselected point, maintain this for a given cycle, shut itself off and reset for the next cycle.



MODEL RP-52-500 A.A. D.C. output, 10-52 volts at 50-500 amperes, automatic programming with upper current limiting.



REMOTE CONTROL PANEL

For more specific and technical information concerning your needs or application, write Crown Chemical and Engineering today, or contact your nearest authorized Crown distributor.

Crown SELENIUM RECTIFIERS

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First Come—First Served

In making room for our magazine files we find ourselves with a surplus of Monthly Review, Plating, Proceedings, and Research Reports. These are being made available to AES members FREE. There will be a charge only for postage. The following chart shows what is available.

This offer expires December 15, 1954

The Monthly Review

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1922	—	—	—	—	—	—	—	18	25	18	19	35
1923	27	14	—	—	15	—	—	—	—	—	—	—
1924	13	13	—	15	13	—	17	27	13	—	—	—
1925	16	19	28	20	22	16	22	15	24	14	24	15
1926	14	10	—	29	32	13	—	15	—	—	—	—
1928	—	—	—	—	—	19	—	—	—	—	—	—
1929	—	—	—	16	—	13	14	24	50	47	37	67
1930	26	30	20	12	—	—	35	—	—	12	—	—
1931	—	10	—	—	—	—	—	—	—	10	9	16
1936	30	—	—	—	—	—	35	11	21	29	—	—
1937	—	—	21	45	23	12	43	—	53	46	25	10
1938	24	13	—	11	28	51	—	—	37	53	47	38
1939	60	15	14	—	27	35	—	23	17	—	14	13
1940	—	10	14	—	11	—	—	—	21	—	—	—
1941	—	—	—	—	—	17	10	—	—	15	19	16
1942	—	—	—	—	—	40	37	53	—	11	—	15
1943	20	42	44	50	38	30	42	58	50	48	44	12
1944	27	37	27	27	49	58	27	27	53	24	42	71
1945	31	44	51	50	48	45	49	46	41	35	32	33
1946	41	49	40	40	33	52	35	37	51	41	43	42
1947	35	36	36	36	35	33	35	48	48	48	42	43

Plating

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1948	—	24	1	62	58	19	23	45	61	58	5	41
1949	14	15	53	38	13	1	21	21	46	16	54	55
1950	—	41	41	32	52	7	52	32	61	2	23	46
1951	55	64	2	64	136	97	72	71	116	122	106	106
1952	90	66	99	105	101	—	—	—	110	69	103	13
1953	—	—	—	—	—	120	30	7	104	91	98	208

Proceedings

1946—107; 1947—241; 1948—49; 1949—28; 1950—242; 1951—75; 1952—98.

Research Reports

$1—126; $2—251; $3—18; $4—216; $6—389; $9—99; $13—42; $14—189; $15—85; $16—293; $17—505; $19—134; $20—31; $21—132; $22—147; $23—176; $24—230; $25—143.

AMERICAN ELECTROPLATERS' SOCIETY

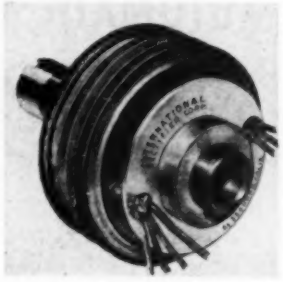
445 BROAD STREET NEWARK 2, N. J.

Equipment and Supplies

under pressure. They are considerably smaller in size and lower in cost than existing regulators for similar applications, the company said. The regulators contain from one to four power-pill units, depending upon the size of the valves.

For further details, use Reader Service Card.

E—1126. Rotating Selenium Rectifier—A rotating selenium rectifier has opened the way for electrical engineers to eliminate the widespread disadvantages of a commutator and slip rings in direct current generators.



The basic principle of applying a rotating rectifier is to mount the unit on the same shaft with the alternator field and a-c exciter. Exciter field is fed from an external d-c supply, which may be another rectifier and a variable transformer. Output from the exciter, usually 3 phase, is fed into the a-c terminals of the rectifier. Output from the rectifier is connected directly to the alternator field windings. Using an a-c exciter eliminates the commutator; and since the rotating rectifier is on the same shaft with the alternator field, the usual slip rings are not required. This eliminates wear and sparking and the resulting interference and brush maintenance.

For further information, use Reader Service Card.

E—1127. New Degreasing Tank—A new vapor-type degreasing tank for the degreasing of tools, engine parts, machine parts, or other metal items is now being marketed by the Bacon Vulcanizer Manufacturiag Company, Oakland, California.

Compact and rugged, requiring minimum shop space, the DG-1 Degreaser Tank is a handy unit for manufacturing plants, repairing shops, service stations, electroplaters, and paint shops.

Completely operated by electricity, this tank reaches full vapor level within 15 minutes, with the level controlled by a thermostat and relay circuit and maintained to within 4 inches of the tank top for uniform cleaning capacity.

The interior is easy to clean and is

DECORATIVE CHROME PLATERS!

THESE PELLETS WILL SAVE YOU MONEY

Zero-Mist, the new completely stable additive for chromium plating baths which eliminates spray and mist, has been introduced by Udylite.

Hundreds of chrome platers are using Zero-Mist and praise its results.

When you use Zero-Mist, spray and mist are absolutely eliminated. Valuable chromic acid does not go out through your air ducts. Washing of exhausted air is not necessary. Chromic Acid waste is cut up to 70%.

Zero-Mist is indestructible at all temperatures and in all concentrations. It is not broken down by the most concentrated boiling chromic acid solutions. High anode or cathode current densities do not affect it. It minimizes staining and reduces drag out losses. Health conditions in plants are improved. It is easy to maintain in the bath. Its control is simple. It lasts and lasts.

If you haven't tried Zero-Mist you should do so soon. Order a trial package today from our local representative or write to:

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

WORLD'S LARGEST PLATING SUPPLIER

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COMPOUNDS
AND CHIPS ARE MADE TO GIVE YOU
THE PROPER FINISH ECONOMICALLY

There are other brands of materials that resemble Roto-Finish chips and compounds . . . but only Roto-Finish chips and compounds give you the *extra advantage* of continuous research by the company who originated the Roto-Finish processes. Roto-Finish chips and compounds are carefully manufactured so *you* obtain the best results on *your specific job*. To obtain the best results at the lowest cost . . . insist on ROTO-FINISH chips and compounds.

ROTO-FINISH puts your grinding, deburring descaling, polishing, brite honing or coloring operations ON A MASS PRODUCTION BASIS

SAVES MAN HOURS AND MONEY by eliminating hand finishing.
GIVES ABSOLUTE UNIFORMITY...in any quantity.
MAINTAINS PRECISION TOLERANCES.
CUTS FINISHING costs as much as 80%.
LOWERS INITIAL and MAINTENANCE costs.

ROTO-FINISH COST-FREE ENGINEERING SERVICE GUARANTEES RESULTS

Put the experience and facilities of Roto-Finish to work for you on your special finishing problems.

Send a few unfinished parts to us . . . plus a finished part as a guide. We *guarantee* that you will get the same results in your plant that we produce in our laboratory. There's no obligation.

Write for fact-packed Roto-Finish catalog for complete information.

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Equipment and Supplies

coated with a special material that is corrosive resistant for durability and long life. It may be converted for use as a hot tank. For further details, use Reader Service Card.

E—1128. New Buff for Copper—The Geo. R. Churchill Co., Inc., announces a new type of cotton finger-type buff, called Type No. 150 DN, especially designed for buffing copper.

Each buff section is made with a double row of overlapped and staggered fingers. Thus the fingers of each adjacent section mold and fit together very compactly, which gives desirable continuity to the working face of the buff.

This specialized construction, developed specifically for the particularly smooth buffing operation required for copper and like metals, is reported to "eliminate all streaking and gouging" and "give the best finish obtainable."

For further information, use Reader Service Card.

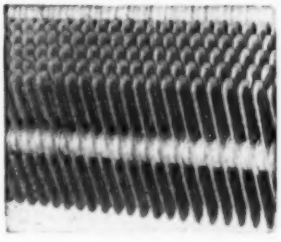
E—1129. NeoFloor Trial Kit—Maintenance and safety engineers will be able to test Pennsalt NeoFloor, the new industrial skidproof surface introduced by the Pennsylvania Salt Manufacturing Company, Philadelphia, without guesswork as to the quantity of the materials necessary for a complete job. A trial kit, sufficient to surface an area of 30 square feet, is now available.

The complete kit offers virtually every type of industrial operation an opportunity to try NeoFloor without quantities of any item.

NeoFloor has given good results in plants where oils, greases, and chemicals create safety hazards. Providing comfortable footing and long-lasting surfaces under heavy traffic, it is a grit-like material anchored in a matrix of resilient neoprene and bonded firmly to the floor or other surface covered with an adhesive primer. Application is easy. Both primer and coating are supplied in a quick-drying liquid form and can be applied with brush

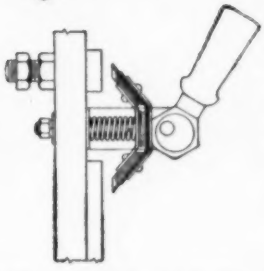
2 Excellent Reasons Why You Should Use COLUMBIA TANK RHEOSTATS!

Cast Grid RESISTORS

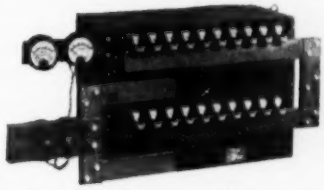


Here are two outstanding construction features of Columbia Tank Rheostats. Durable Cast Grid Resistors are resistant to chemical fumes and capable of withstanding intermittent and momentary overloads.

TOGGLE SWITCHES



Toggle switches, easily operated, self-cleaning, cam type to give a quick break and a positive contact. Consider these and other important Columbia features when selecting tank rheostats to give long life service and effective plating control.



Standard sizes from 15 to 5000 amperes, 1 to 6-volt drop. Other voltage drops as specified. Furnished complete with voltmeter, ammeter and shunt. Short Circuiting Switch available.

For the complete story of why you should use Columbia Tank Rheostats, write today for Bulletin PL-500.

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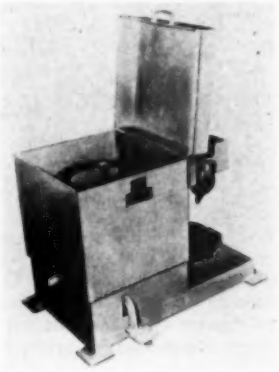

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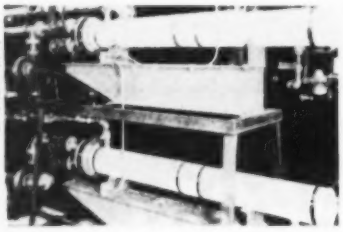

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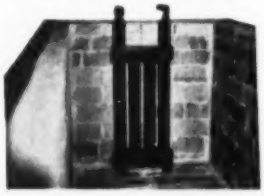

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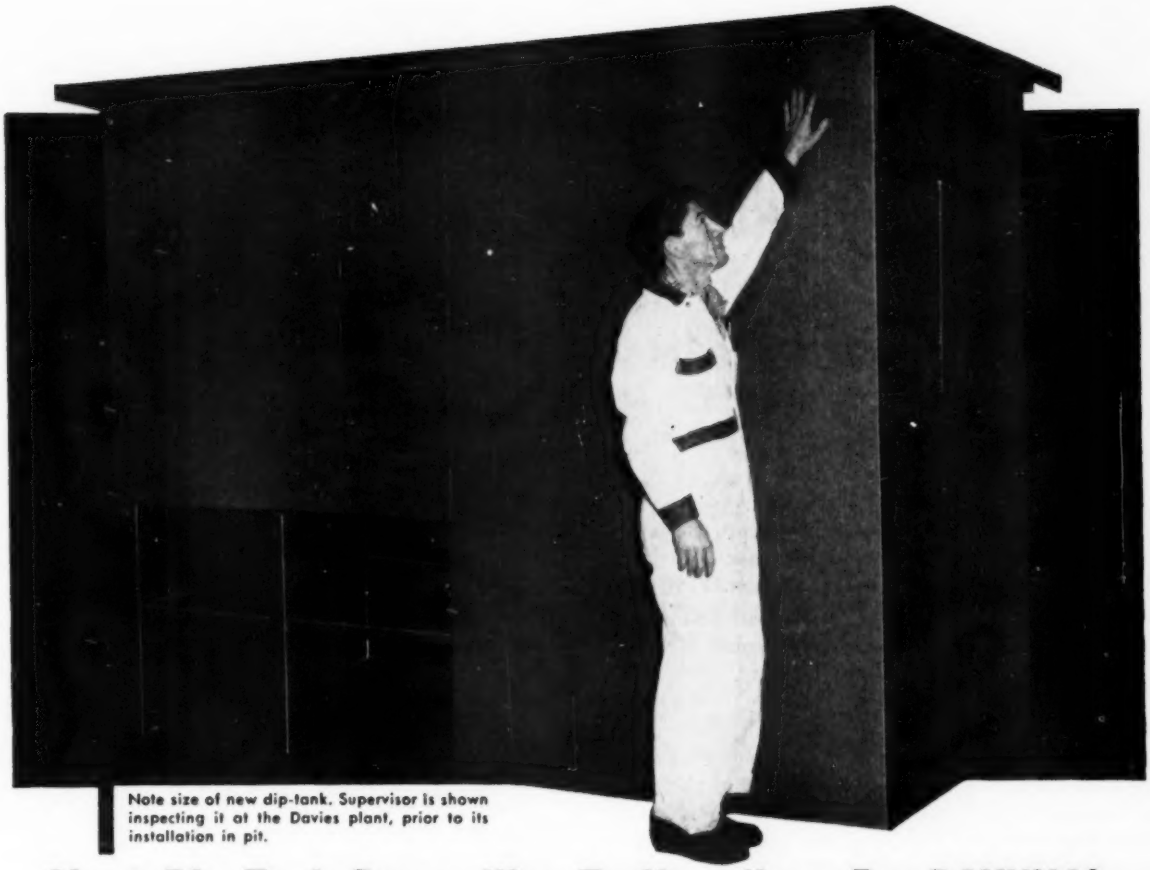

Note size of new dip-tank. Supervisor is shown inspecting it at the Davies plant, prior to its installation in pit.

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A PRACTICAL APPLICATION OF ELECTROLESS NICKEL PLATING*

JOHN D. MacLEAN† AND SEYMOUR M. KARTEN‡

Introduction

Deposition of nickel by chemical reduction was developed and reported by Dr. A. Brenner and Grace Riddell of the National Bureau of Standards in 1946.[1]

This paper deals with a practical application of this process to work done on steel components of bomb fuzes.

Development

Naval Ordnance specified electroless nickel on three parts of the fuze because of the ability of this type of solution to plate evenly to the bottom of small blind holes. Unlike the standard electrolytic nickel, this process does not depend on chemical and electrical setup for throwing power, since deposition will occur anywhere the solution touches the work. This is particularly important in the case of the rotor of the fuze.

Figure 1 shows a drawing of the rotor in cross section with the deep blind holes in evidence. With the standard nickel it would be impossible to "throw" to the bottom of these holes, while with the electroless nickel complete coverage is obtained.

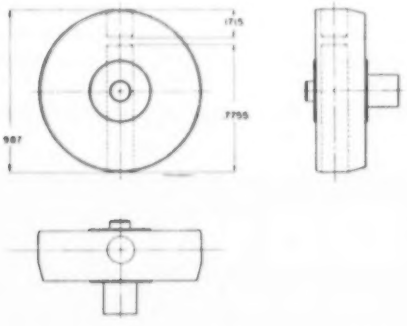

Fig. 1. Diagram of fuze rotor which is plated to bottom of blind holes

Many small parts used in the fuze are flat and nest readily. For this reason, even standard barrel plating practice is not good enough to insure 100 per cent coverage. However, it was found that work of this type is admirably suited to basket plating in the electroless nickel solution. Figure 2 shows some representative pieces of this type that are basket plated in the electroless nickel bath with only intermittent hand agitation. The covering ability of the electroless nickel method is so phenomenal that all our fuze parts are plated in baskets with excellent results.

Several different types of electroless nickel solutions are described by Brenner and Riddell.[1] After much experimentation, it was decided to use the citrate type because of its increased brightness and ease of control. While the rate of deposition for this type was slower than some others, it was felt that brightness was of prime importance and work was done to increase the rate of deposition. This was accomplished by increasing the nickel and hypophosphite concentrations.

Several problems had to be worked out in order to transfer this process from a laboratory to a plant scale.

The first and most obvious problem was maintenance of the solution. Since no anodes are used, nickel concentration becomes depleted quite rapidly in production. Also, the hypophosphite and ammonia are consumed quite fast in the process. All three of these components must be replenished at frequent intervals. The problem was to determine the proper concentration of these chemicals as well as the frequency of the additions necessary. A replenishing stock solution high in nickel concentration was developed. This is discussed further in the paper under solution control.

The second problem involved the choice of tanks for this solution. Small nickel particles precipitate out on the bottoms and sides of the tank even though

*Presented at the Forty-First Annual Convention of the American Electrodepositors' Society on 13 July, 1954.
†Chief Electroplating Chemist, Bulova Watch Company, New York, New York.
‡Chemist, Bulova Watch Company, New York, New York.

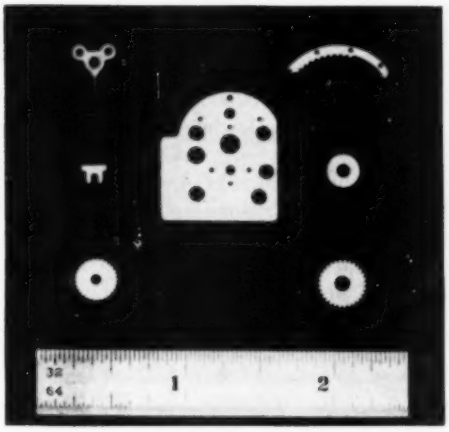

Fig. 2. Typical small flat parts, basket plated in bulk with electroless nickel

Fig. 4. View of electroless nickel plating line

the tank is nonmetallic. To prevent these particles from building up and taking more nickel out of the solution, the tanks are decanted daily and treated under a hood with 50 per cent nitric acid. For this reason, the tanks are kept small, so that they can be readily changed. A 2½ gallon white-glazed stoneware pot was decided upon as ideal for this purpose.

Equipment

The plating lines are set up as complete units. This is shown in Fig. 3. Each unit contains a hot electric cleaner, cold electric cleaner, acid dip, two nickel plating tanks, two rinse tanks with overflow dams, centrifugal dryer, and degreaser. Once the line is loaded at all stations, the operator's time is taken up in loading baskets, transferring work from station to station, rinsing, agitation of the baskets, and unloading. Since the plating time is eight minutes, two nickel plating solutions are used so that by alternating, a load will come out every four minutes.

The baskets used are No. 16-gauge stainless steel mesh with stainless steel rivets and handles. The baskets build up gradually with nickel but are easily stripped once a week in 50 per cent nitric acid under a hood. Some baskets have been in use for a period of over two years and are still serviceable.

A centrifugal dryer is used for drying most parts with a drying time of about three minutes.

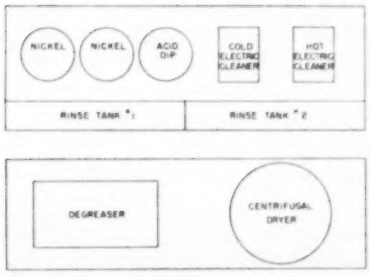

Fig. 3. Diagram of cleaning, plating, and drying setup for electroless nickel

In the case of the rotor, the drying is done by dipping through two alcohol dips and placing in the vapor zone of a standard trichlorethylene degreaser for about five minutes.

The nickel plating process is carried out at a temperature of 195° F. The white stoneware tanks are set in a water bath, which consists of a steam-jacketed stainless steel tank. An additional source of heat is required. This is supplied by two 500 watt quartz electric immersion heaters.

Excellent ventilation is necessary when using ammonia at 195° F. This is accomplished through the use of special stainless steel hoods, which curve around one side of the nickel plating tank and are connected to an exhaust fan. This is shown in Figs. 4 and 5.

Operation Sequence

A. Hot alkaline cleaner—4 oz/gal—reverse current—4 volts—15 amps—180° F—time: 4 minutes

B. Rinse in running water

C. Cold caustic cyanide cleaner—4 oz/gal—KOH—4 oz/gal—NaCN—direct current—stainless steel

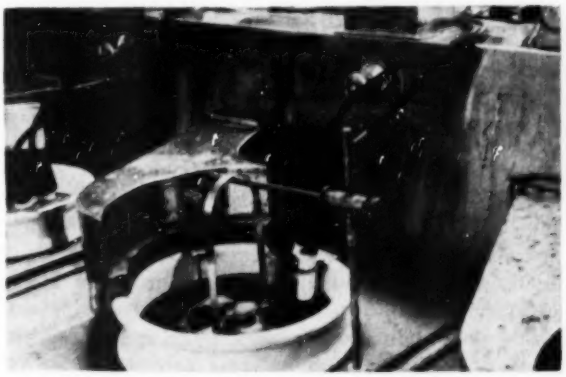

Fig. 5. Closeup of plating tank with immersion heaters and basket

anodes—4 volts—15 amps—room temperature—time: 1 minutes

D. Rinse in running water

E. Acid dip—20% H_2SO_4—room temperature—time: 10–20 seconds

F. Rinse in running water

G. Nickel plate—195° F—time: 8 minutes

H. Rinse in running water

I. Final rinse—water + 2 oz/gal wetting agent

J. Dry in centrifugal dryer—time: 3 minutes

K. Alternate drying method: 2 methanol dips may replace wetting agent and water

NOTE: The baskets are agitated in the cleaners and nickel solution by shaking for two to three seconds, once a minute.

Solution Control

Four solutions are used in the control of the electroless nickel plating process. These are:

A. New nickel solution

B. Replenishing nickel solution

C. Hypophosphite solution

D. Ammonia solution

The following is the composition of these solutions:

Composition of New Solution

Nickel chloride—$NiCl_2.6H_2O$	6.0 oz/gal
Ammonium chloride—NH_4Cl	6.7 oz/gal
Sodium citrate—$Na_3C_6H_5O_7.5H_2O$	13.4 oz/gal

These chemicals are dissolved in water and filtered.

Composition of Replenishing Solution

Nickel chloride—$NiCl_2.6H_2O$	20.0 oz/gal
Ammonium chloride—NH_4Cl	2.0 oz/gal
Sodium citrate—$Na_3C_6H_5O_7.5H_2O$	6.0 oz/gal

These chemicals are dissolved in water and filtered.

Composition of Hypophosphite Solution

Sodium hypophosphite—$NaH_2PO_2.5H_2O$	60 oz/gal

This is dissolved in water and filtered.

Composition of Ammonia Solution

One part concentrated ammonia water is diluted with two parts water.

The new nickel solution is heated to 195°F, and 3 fluid ounces of the hypophosphite solution are added for every gallon of nickel solution used. Ammonia solution is added until the first permanent blue color is obtained. This will represent a pH of 8.5 to 9.0. The solution is now ready for operation.

Since the nickel will plate out of the solution, it must be replaced. This is done with the replenishing solution. Approximately 4 fluid ounces of the replenishing solution per gallon of nickel solution are added every hour of operation. An indication of sufficient nickel present in the plating solution is the appearance of a white precipitate upon further addition of the replenishing solution.

The hypophosphite is used up in the plating process also. This is replaced by adding approximately 1 fluid ounce of hypophosphite solution per gallon of nickel solution every half hour.

Moderate gassing on the work being plated should occur at all times. A slowing down of this gassing is an indication of low hypophosphite content and can be remedied by the addition of more hypophosphite solution. An excess of hypophosphite will result in violent gassing, which may precipitate all the nickel in the solution and is to be avoided.

With sufficient nickel and hypophosphite in the solution, ammonia solution is added to the first permanent blue color as in starting the solution.

An excess of ammonia will boil off and be of no value.

A commercial grade of sodium hypophosphite has been made available at about one half the price of the cp salt. This was tried and found to be satisfactory.

Chemical analysis of this solution was found not to be feasible in running production lines since the concentrations of the various chemical components changed so rapidly that, by the time the analysis was completed, the concentration would be radically different from what it was when the sample was taken. For this reason, the empirical method of control described above was devised.

Conclusions

The electroless nickel solution in use, as described above, is particularly suited for plating small steel parts. Thickness of plates required is only 0.00006–0.00008 inches and can be deposited in eight minutes. Since the fuze parts require close dimensional tolerances, serious difficulties would arise if the plate thickness varied to any extent in a load. However, good uniformity of plate thickness was obtained with the electroless nickel solution. Such uniformity could not be approached even with closely controlled standard nickel barrel plating solutions.

The electroless nickel plate has the further advantage of being bright, smooth, and free of all pitting and burning. The adhesion of this plate is excellent, using the cleaning cycle described. Some brittleness has been observed at plate thicknesses roughly twenty times our standard. However, at 0.00007 inch no sign of brittleness is apparent.

The cost of chemicals for this process amounts to $0.02 per square foot at 0.00007 inch thickness.

Many parts that would have to be racked, using standard nickel plating procedures, can be plated successfully in a basket with the electroless nickel. This saving in time and labor becomes very significant with large production. Small flat parts can be covered completely by basket plating in the electroless nickel solution with only intermittent hand agitation. No dark areas indicating incomplete coverage are evident in this process.

With three plating lines as described, over two million pieces are plated per forty-hour week. Use of the

electroless nickel solution has permitted this high production with a minimum of rejections. This production, at a consistently high level of quality, would not have been possible using the standard nickel solution.

ACKNOWLEDGMENT

The authors wish to thank Mr. David Anderson, production manager of the Woodside plant of the Bulova Watch Company, for his cooperation.

REFERENCES

"Deposition of Nickel and Cobalt by Chemical Reduction," by Abner Brenner and Grace Riddell, National Bureau of Standards Research Paper, R.P. 1835, Vol. 39, November 1947.

DISCUSSION

MR. FRANK O. BEUCKMAN (Eastman Kodak Company, Rochester, N. Y.): What are the normal deposition rates?

MR. MACLEAN: As we said in the paper we could plate approximately 0.00001 inch per minute. We put 0.00008 inch of nickel on in eight minutes.

MR. BEUCKMAN: How long do these rates last? In other words, how long can you use these same solutions?

MR. MACLEAN: We have had some solutions in operation about two years. We do not change the solution. Simply by adding the stock solution, we can keep the process going.

MR. BEUCKMAN: How do you get rid of the phosphite that builds up?

MR. MACLEAN: We decant the solution every night leaving 10 to 15 per cent of the solution behind.

MR. HARRY R. TAYLOR (Lycoming Division of Avco, Stratford, Conn.): Do you do any annealing of your electroless nickel for hardness?

MR. MACLEAN: No.

MR. TAYLOR: Have you done any electroless nickel on aluminum?

MR. MACLEAN: No, we have not. We have plated the electroless nickel on brass.

MR. TAYLOR: Have you found the nickel is not too passive so that you can plate another deposit on it?

MR. KARTEN: It is very active, it is very easy to plate nickel on nickel, if steel is present to start the reaction.

MR. J. M. WELLER (Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.): Is there any special type of coating used on the stainless steel basket?

MR. KARTEN: No coating at all.

MR. WELLER: In the electroless nickel process are the factors affecting adhesion the same as in electrodeposits?

MR. KARTEN: Yes.

MR. WELLER: How about adhesion of this electroless nickel on other deposits? We have certain applications where we want a nickel thickness of about 0.003 to 0.004 inch. We deposit this thickness from a Watts bath. On certain other areas of these parts we want electroless nickel. Would you anticipate any problem of adhesion of this electroless over electrodeposited nickel?

MR. MACLEAN: We can plate nickel on top of the electroless nickel so that we should not have any trouble.

MR. WELLER: How about on chromium?

MR. MACLEAN: No, we have never tried plating on chromium. I doubt if it would work.

MR. NORMAN A. TOPE (Montgomery Plating Company, Ltd., Coventry, England): Can the process be adopted to deposit 1½ to 2½ mils on nickel and what is the softest deposit that can be obtained?

MR. MACLEAN: I would say that you could deposit that thickness. As far as the hardness or the softness is concerned, we have not made any such determinations.

MR. PHILIP H. EISENBERG (Sylvania Electric Products, Inc., Bayside, N. Y.): Since we have done a certain amount of work with electroless nickel solutions, I would like to answer the last question. Although thick deposits can be built up with electroless nickel, this particular type of solution would prohibit it because of the slow deposition rate—approximately 0.2 mil per hour. We at Sylvania have built up deposits as thick as 4 mils with the use of other types of elecless nickel solutions.

Have you determined how much hypophosphite you use to deposit a gram of nickel?

MR. KARTEN: Offhand, I would say we have not determined quantities of hypophosphite that would deposit a definite amount of nickel.

MR. EISENBERG: What is the phosphorus content in the nickel that you deposit?

MR. MACLEAN: We don't know.

MR. KARTEN: It would probably be the same as other deposits from an electroless nickel bath.

MR EISENBERG: There has been information published giving a range of anywhere from 7 to 12 per cent. I wanted to know whether or not you determined what per cent you deposited with this particular bath?

MR. KARTEN: We have not done any work on that.

MR. R. F. WALTON (RCA Victor Division, Harrison, N. J.): Would an electroless nickel deposit on steel wire have sufficient adhesion to withstand annealing and drawing?

MR. MACLEAN: Although we have had no experience plating on wire I feel the electroless nickel should have sufficient adhesion for this if the cleaning cycle includes a 20 per cent sulfuric acid dip as described in our paper.

DISPOSAL OF PLATING WASTES AT A SILVERWARE PLANT*

BARNETT F. DODGE† AND CHARLES A. WALKER‡

Introduction

Sherrill Plant of Oneida Limited is located in the midst of a rural area containing many dairy farms and numerous small streams and lakes which afford opportunity for recreation to thousands of people. The manufacture of plated and sterling silverware and of numerous items for the armed forces necessarily involves the use of large quantities of various acids, cleaners, heavy metals, and cyanides, much of which is eventually discharged from the plant mixed with water. Preservation of the waterways of the area in their natural state is desirable from the viewpoint of the inhabitants, particularly the farmers and sportsmen. The meeting of the obligation to discharge clean effluents is frequently difficult in the case of a metal working industry and is rendered particularly difficult in this case because the flow rate of the receiving stream nearest the plant (Sconondoa Creek) is at times no more than five times the flow rate of the total manufacturing plant effluent. Nevertheless the management of Oneida Limited early recognized its obligations and has carried steadily forward a development program of adequate waste disposal and treatment.

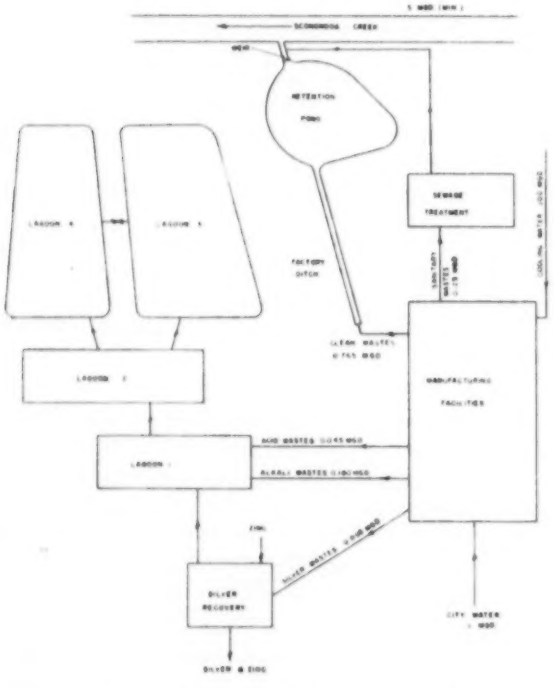

Fig. 1. Waste disposal prior to 1953

The magnitude of the problem may be realized by reference to Fig. 1, which shows the waste disposal scheme for Sherrill plant as it existed from 1941 to 1953. It will be noted that the 1,100,000 gallons of water used daily in the plant was discharged as:

Sanitary wastes (125,000 g.p.d.) to sewage treatment and then to Sconondoa Creek.

Clean wastes (765,000 g.p.d.) to a factory ditch and then to Sconondoa Creek.

Contaminated wastes (210,000 g.p.d.) to a system of lagoons.

One feature of this system, which should be noted particularly, is the retention basin at the outlet end of the factory ditch. This basin was installed in 1951 to minimize the effects of small slugs of more concentrated wastes which might occasionally appear in the plant discharges.

The practice of lagooning the contaminated wastes constituted no more than a temporary solution to the waste disposal problem since there are definite limits to the amount of water which can be disposed of by seepage and evaporation within a given area. Basically the work undertaken was that of developing facilities for purifying the contaminated wastes to a degree which would permit the discharge of an effluent directly into the factory ditch. This would reduce to a practicable minimum the amount of waste sent to a much smaller lagoon area and would result in approximately the following flows to Sconondoa Creek:

*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, 13 July 1954.

†Professor of Chemical Engineering and Chairman of the Department of Chemical Engineering, Yale University, New Haven, Connecticut.

‡Associate Professor of Chemical Engineering, Yale University, New Haven, Connecticut.

Sewage treatment effluent (125,000 g.p.d.)
Clean wastes (765,000 g p d.)
Waste treatment effluent (210,000 g.p.d.)

Since these wastes must be fed into a receiving stream having scarcely five times the flow rate of the wastes, it is obvious that an unusually high degree of removal of contaminants is required.

It was decided in 1951 that a more complete solution to the problem of waste treatment should be sought as rapidly as possible. Beginning with the situation depicted in Fig. 1, there has been developed a system of waste treatment which will eliminate the necessity for lagoons with the exception of a small area to be used for the purpose of receiving skimmings and metal hydroxide sludges, and also as a safety factor, i.e., to receive raw factory wastes in the event of a shutdown of the waste treatment plant or to receive any wastes which are found to be excessively difficult to treat properly.

This paper is devoted to a description of the development which preceded the design of the plant, a description of the plant, and a report on the first few months of operation. It may be noted that any development of waste treatment facilities will involve the basic steps outlined here, some of which may not be obvious until the program is underway.

Segregation of Wastes

One of the initial steps in the development of waste treatment facilities is a thorough study of waste segregation from two points of view. First, consideration must be given to reducing the volume of wastes to be treated by routing plant effluents which are consistently clean directly to the receiving waterway. Second, the problem of separating wastes into types suitable for treatment must be considered. In deciding on the routing of waste streams, it will be found that plant records of chemical usage, directions for preparing various baths, etc., will be adequate in many cases to indicate that a particular stream is to be classified as clean or contaminated. In borderline cases, it may be necessary to have some knowledge of flow rates and compositions of the waste streams. The choice of routing with regard to suitable separation into types for treatment will obviously depend on the treatment methods to be used. The question of segregation must be considered both prior to and simultaneously with the next phases of the development program.

In the case of Sherrill Plant the initial segregation scheme depicted in Fig. 1 was planned and installed in 1941, largely with the intent of separating contaminated wastes from clean wastes. Decisions as to routing of the streams were made largely by a study of plant records with relatively few flow rates and stream compositions being determined. The segregation into dirty and clean wastes was quite efficient, as is evident from the fact that a typical analysis of the factory ditch water indicated about 1 p.p.m. free cyanide and 1.5 p.p.m. copper. It was decided, however, that the concentrations of such contaminants had to be reduced still further in order to insure a healthy stream. In order to revise routings to reduce the concentrations of free cyanide and copper in the factory ditch to levels less than 0.1 p.p.m., it was necessary to survey numerous borderline cases by flow rate and composition determinations. It was further necessary to check the routing of all waste drains in the plant by fluorescein tracing. As a result of several months of study, the average concentrations of cyanide and copper in the factory ditch water were reduced five to tenfold, i.e., from about 1 p.p.m. to about 0.1–0.2 p.p.m. This improvement resulted from changes in the routing of about twelve streams.

In the segregation system, as planned in 1941, the contaminated wastes were divided into the following classes:

Acid wastes (consisting almost entirely of rinses and dumpings from a bright dip operation and from a silver stripping operation).
Silver-bearing wastes.
Alkali wastes.

The so-called alkali wastes were actually no more than a combination of all wastes which could not be classified as acid or silver-bearing. From the point of view of separation of the wastes into appropriate types for treatment, it was obvious that two objections might be raised to this segregation scheme. First, the last two of these wastes contain cyanides, making it necessary that two cyanide treatment units be installed in the plant. This condition cannot be avoided, however, except by routing all cyanide-bearing wastes into the silver-bearing wastes. This would result in excessive dilution of the silver solutions. Second, the development of cyanide removal methods for the alkali wastes might be rendered difficult by the presence of contaminants such as oils, soaps, etc. Thus, the final decision as to the suitability of this segregation had to await the laboratory studies of treatment methods. Adequate methods for treating the complex alkali wastes were developed, with the result that the existing segregation system was found to be satisfactory.

Survey of Wastes

The course of a waste survey depends to a considerable extent on whether the proposed treatment plant is to be operated batchwise or continuously. Average flow rates and compositions are of greater interest if batch processing is to be used, whereas instantaneous flow rates and compositions are more useful if continuous processing is to be used. On the other hand, the decision between batch and continuous processing is made partly on the basis of the degree of variation in flow rates and compositions. Thus it is frequently necessary that a survey include determination of both instantaneous and average values. This was true for this survey.

In determining the compositions of liquid wastes from Sherrill Plant, it was decided first that chemical analysis would be restricted to potentially toxic or recoverable materials (specifically copper, nickel, zinc, cyanide,

TABLE I. FLOW RATES OF WASTE STREAMS

Waste	Flow Rates g.p.h.	Flow Rates g.p.d.	Notes
Silver		5,000	Highly variable since waste originates in dumpings
Acid	4,500	40,000	Flow rate constant, 7 A.M.–4 P.M. Essentially zero on night shifts
Alkali	12,500	160,000	Flow rate constant, 7 A.M.–4 P.M. Flow on night shifts variable depending on production

silver). The average concentrations of other materials (soaps, kerosene, etc.) could be obtained from plant records on make-up of various baths. Although the methods of spot and composite sampling were initially employed, it became apparent rather early in the study that a method of batch processing would probably be selected. Hence, emphasis was placed on the analysis of composite samples, some obtained by simple blending of spot samples and others by true continuous sampling. The samples were analyzed for free cyanide, copper, nickel, zinc, and silver by polarographic methods and for total cyanide by a distillation method.

TABLE II. COMPOSITIONS OF WASTE STREAMS

Waste	Components	Concentrations, p.p.m. Min.	Max.	Aver.
Silver	Silver	6	2,000	270
	Copper	3	900	12
	Nickel	0	30	5
	Zinc	0	25	9
	Free CN.	3	2,800	116
	Total CN.	9	3,940	155
Acid	Sulfuric Acid			1,740
	Nitric Acid			2,020
	Hydrogen Chloride			243
	Caustic Soda			14
	Sodium Bichromate			1.8
	Silver			1.1
	Copper	30	590	135
	Nickel	10	130	33
	Zinc	5	220	65
	Iron			0.4
Alkali	Silver			0.2
	Copper	3.2	19	6.1
	Nickel	0.4	3.2	1.9
	Zinc	0.5	5.1	2.2
	Total CN.	7.8	91.5	21.7

NOTE: Alkali Waste also contains soap, borax, orthosilicates, kerosene, pumice, etc.

In determining the flow rates of liquid wastes from Sherrill Plant, the most useful single source of information was a knowledge of the flow rate of each of the more than 110 running rinses in the plant. The data on these flow rates were obtained by lowering the liquid level in any tank (either by a bottom drain or a siphon) and noting the time required for the level to rise some distance. This was done on a Saturday morning when no manufacturing was in progress with all rinses running in order to simulate conditions existing during normal plant operations. With these basic data, it was possible to calculate the total flow in any given waste collection line, to calculate readily the effect of a change in routing, etc. The figures were checked by gaging waste collection sumps where possible. Another source of flow rate data was available when all of the water supplied to a given manufacturing unit was routed to a single waste collection line. In these cases water meters were placed on the inlet line to the manufacturing unit. This scheme was particularly convenient in the cases of a bright dip unit and an acid strip unit.

The results of the waste survey are presented in Tables I and II. These tables summarize the results of several hundred chemical analyses and flow rate determinations.

Laboratory and Pilot Plant Investigations of Treatment Methods

The advisability of laboratory and pilot plant investigations of methods for treating the liquid wastes from Sherrill Plant resulted from the somewhat unusual nature of the wastes and from the necessity for producing effluents with relatively low concentrations of toxic materials. It was felt that such investigations would be economically sound because of the firmer design basis which would result from the knowledge obtained. Hence laboratory and pilot plant studies were initiated for the purpose of developing methods which would produce effluents containing less than 1 p.p.m. each of copper, zinc, and total cyanide. Dilution of such effluents by the clean wastes from Sherrill Plant and by the water of Sconondoa Creek should result in a healthy waterway.

Alkali Wastes

The alkali wastes from Sherrill Plant contain relatively low concentrations of cyanide and the heavy metals in the presence of considerable organic matter, much of which is in suspended form. Adequate treatment of these wastes obviously requires removal of cyanides, heavy metals, and organics. Although several other methods of treatment were investigated briefly, it soon became apparent that the following scheme represented the best possibility:

Step 1—Skimming

A considerable amount of kerosene, soaps, etc., sepa-

rated fairly readily from the wastes and could be removed by skimming.

Step 2—Oxidation of cyanides

The oxidation of cyanides to carbon dioxide and nitrogen by means of chlorine or sodium hypochlorite was found to be quite effective and moderately rapid. This could be carried out with 7.5–8.5 pounds of available chlorine per pound of cyanide, allowing about two hours for reaction if the *p*H was maintained at 8.5 for the complete oxidation. If the oxidation were to be carried out in two steps, twenty minutes would be allowed for the oxidation of cyanide to cyanate at *p*H 10.5. The oxidation of cyanate to carbon dioxide and nitrogen would require an equal period of time after a *p*H adjustment to 6.5.

Step 3—Acidification and skimming

Further skimming could be carried out by adding acid to lower the *p*H of the alkali wastes to 3 or less. This acidification was accomplished by using either acid wastes or ferric chloride.

Step 4—Precipitation of heavy metals

The heavy metals involved here form insoluble hydroxides and could therefore be precipitated by the addition of lime. The resulting heavy metal floc served also to clarify the wastes by adsorbing suspended matter (such as soaps and oils), provided the concentration of heavy metals was high enough.

Step 5—Thickening and filtration

Removal of the heavy metal floc by simple settling was found to be effective on a laboratory scale. Filtration of the effluent through sand was found to be necessary to insure consistently low concentrations of heavy metals in the effluent.

The procedure outlined above was applied to about a hundred 1-liter samples of alkali wastes to make certain that the treatment would be adequate. It was further tested on 5-gallon lots of the wastes and finally on a large pilot plant scale, using 27,000 gallon batches. In all cases it was found to result in sparkling clear effluents with less than 1 p.p.m. each of copper, zinc, and cyanide.

Acid Wastes

It was noted above that the acid wastes could be used to serve the double purpose of acidifying the alkali wastes prior to skimming and providing heavy metals for floc formation.

Silver Wastes

An obvious method of treating the dilute silver-bearing wastes from Sherrill Plant appeared to be that involving oxidation of cyanides by chlorine or hypochlorites. This process would be expected to result in the precipitation of silver as the chloride, with the result that cyanide oxidation and silver recovery would be accomplished simultaneously. Laboratory investigation showed that such a method would be satisfactory except that the precipitated silver chloride was in very finely divided form that settled slowly. The settling characteristics were improved by carrying out the oxidation in the presence of silver chloride from previous batches that favored particle growth rather than formation of new nuclei. This method was investigated thoroughly, beginning with 1-liter laboratory batches and ending in pilot plant runs on 600-gallon lots. It was found to be adequate in all cases.

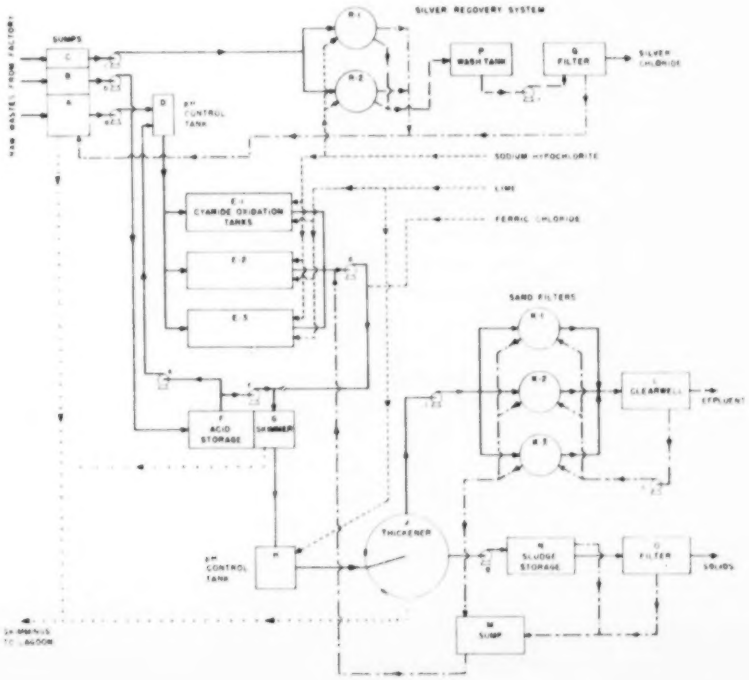

Fig. 2. Flow diagram for treatment of acid and alkali wastes

Design of Plant

Two of the questions which must remain uppermost in the minds of designers of waste treatment facilities are:

1. Does this design provide sufficient control over the processing to insure an adequate effluent at all times?
2. Is this design sufficiently flexible to provide for future changes in the flow rate and composition of raw wastes?

Affirmative answers to both of these questions must be obtained in the design. The design procedure must be based on a consideration of these two questions, along with considerations of recovery of values, batch versus continuous processing, 8-, 16-, or 24-hour per day operation, degree of automatic control to be provided, etc. The answer will usually be obtainable only by laying out several basic designs and making preliminary cost estimates. This procedure was followed in the present case, with the result that a plant corresponding to the flow sheet of Fig. 2 was found to be the optimum solution to this problem.

Following is a description of the flow sheet and relates the conditions that had to be met in the design of the waste treatment plant. The three types of waste flow by gravity from the various areas in the factory to the three waste collection sumps designated as "alkali," "acid," and "silver-bearing cyanide."

Treatment of Silver-Bearing Cyanide Waste

The silver-bearing waste is transferred to two 12,000 gallon concrete silver recovery tanks (R) each equipped with an agitator. These tanks are filled and treated alternately and their combined capacity was determined by a full week's flow allowing 2½ days each for treatment and draining.

Sodium hypochlorite is added to the contents of the filled tank to oxidize cyanide, 3.5 pounds available chlorine being allowed per pound of cyanide. The mixture is agitated for four hours and allowed to settle for twelve hours. The cyanide is oxidized to cyanate only.

The supernatant is decanted to the alkali waste sump where it is intermixed with the alkali waste for later oxidation of the cyanate in the alkali waste treatment.

After every seven batches have been treated, 50 per cent of the precipitated silver chloride is removed to a 2,000 gallon sump (M), treated with acid, and filtered. The filter cake is refined for recovery of pure silver.

Treatment of Acid and Alkali Wastes

The acid waste is transferred to an acid storage tank (F) for further controlled distribution. (See Fig. 2.) The capacity of this tank (F) is 55,000 gallons, and hence it is capable of blending the varying flows to a fairly constant mixture.

The alkali waste is transferred from the alkali waste sump (A) to three cyanide oxidation tanks (E), passing enroute through a *p*H adjustment tank (D) where the *p*H is either raised with the addition of lime slurry or lowered by the addition of waste acid to a *p*H of 10.5.

The cyanide oxidation tanks are filled in rotation on the basis that one tank is being filled while a second is being treated and the third is being emptied. Each of these tanks has an 80,000 gallon capacity. This was determined not by the maximum length of time required for batch treatment of the cyanide which requires little time, but by consideration of the operator's duties.

The batch oxidation procedure involves the determination of total cyanide by a distillation method and of cyanate by a modified Nessler method. The *p*H of the waste to be treated is adjusted to at least 9 and the required hypochlorite is added (7.5 parts of available chlorine per part of total cyanide and 4 parts of available chlorine per part of cyanate). At this *p*H the oxidation of cyanide to cyanate is completed within 10–15 minutes upon thorough mixing. The *p*H of the waste (with all cyanide now oxidized to cyanate) is lowered with waste acid to 6.5–7. At this *p*H the oxidation of cyanate to carbon dioxide and nitrogen is completed in 10–15 minutes.

The choice of the two-stage cyanide oxidation scheme (oxidation of cyanide to cyanate at *p*H 9 and oxidation of cyanate at *p*H 6.5) was actually made after a few weeks of plant operation. Operating data on this procedure, contrasted with data on the procedure in which both stages of the oxidation were carried out at *p*H 8.5, revealed that the two-stage oxidation is far superior to the single *p*H method. The probable reasons for this are:

1. The carrying out of the oxidation, successively, at the two *p*H values is specifically aimed at accomplishing the two oxidation steps most effectively and rapidly. Data indicating and confirming these facts are presented in the report of AES Project No. 10, "Disposal of Plating Room Wastes."
2. The efficiency and rapidity of the two fundamental oxidations at optimum *p*H values minimizes the undesirable effect of extraneous chlorine demand (organic in nature) being asserted prior to completion of the desired oxidation steps, a condition which arrests the completion of the oxidation to carbon dioxide and nitrogen and stabilizes some cyanide in the intermediate, cyanogen chloride-hydrolysis state. In addition, the two-stage oxidation procedure, being based specifically on cyanide and cyanate content, insures against the addition of amounts of available chlorine greater than actually required for complete oxidation of cyanogen compounds.

The partially treated alkali waste is transferred to a skimmer tank (G) being joined by a flow of waste acid to reduce the *p*H to 3 or less. Should there not be sufficient metals present to form a suitable floc during a later operation, ferric chloride is added at this point. At the lowered *p*H any soaps and oils present will

TABLE III. OPERATION OF SILVER RECOVERY UNIT

Batch No.	Analysis of Raw Waste			Analysis of Supernatant		
	Total CN^- (p.p.m.)	*p*H	Silver (p.p.m.)	Silver (p.p.m.)	Total CN^- (p.p.m.)	Excess Cl (p.p.m.)
1	642	10.7	564	8.2	70	34
2	829	10.65	585	4.4	86	149
3	509	11.15	401	2.7	35	794
4	348	10.4	331	6.5	30	14
5	389	10.7	364	2.7	54	77
6	672	10.6	533	5.1	56	51
7	431	10.7	440	0.7	40	116
8	159	10.2	130	0.0	15	173

appear as skimmings and are removed to the lagoon.

The mixture of alkali and acid waste flow continuously through the skimmer and then through a *p*H adjustment tank (H) where lime slurry is added to raise the *p*H to 8.5 for the formation of metal hydroxides. The continuing flow passes through a thickener (J) where most of the sludge is settled out and removed to a sludge collection tank (N), which discharges the final sludge to a lagoon.

The effluent containing small amounts of settleable solids is passed through gravity sand filters (K) to the clearwell (L) and discharged to the factory ditch where it mixes with the "clear water" wastes and discharges into Sconondoa Creek.

Waste water from backwashing the gravity sand filters is collected in a tank (N), from where it is introduced into the treatment system as partially treated alkali waste.

One of the outstanding features of this waste treatment plant is a graphic panel from which the plant can be operated. The flow sheet of the entire plant is depicted on this panel. Remote control operation of all the major valves and pumps from the panel is provided. Also provided are:

1. Automatic control of the *p*H of the alkali wastes flowing to Tanks E. This was provided because *p*H is of great importance in determining the rate of cyanide oxidation.
2. Automatic control of the *p*H of the mixture flowing to the thickener. *p*H is a major control variable in determining the effectiveness of heavy metal precipitation.
3. Indicating and recording of liquid levels in Tanks E and R, to provide the operator with this essential information and to preserve a record of batches treated.
4. Continuous samplers for the major points in the plant (Tanks E, R, L).
5. Flow controls (manually set) for the wastes leaving Tanks E and F.
6. Loss-of head indicators and an automatic backwash system for the sand filters

It is not common practice in waste treatment plants to use automatic controls and instrumentation to the degree that they have been used in this plant. Their use in this case is justified simply by the fact that the dilution available for the waste treatment effluent is so low that the possibility of mistakes in treatment must be reduced to a minimum. The controls also reduce the manpower required for operating the plant sufficiently to justify a large part of the investment.

Operating Results

Basically, the processing of wastes has gone smoothly according to the proposed treatment procedures. The complete success of the entire treatment can be seen by noting Tables III and IV. Because of the complexity of the treatment involved and due to the fact that each waste treatment problem has its own peculiarities and requirements, it was anticipated that problems would arise necessitating changes and modifications to the treatment process and processing equipment. The design of the plant was so flexible that necessary changes and modifications were and are being made with a minimum of difficulty.

The success of the silver recovery system is indicated in Table III. It will be seen from the data in that table that the average silver content of the raw wastes is about 400 p.p.m. whereas the average silver content of the supernatant is about 4 p.p.m. These figures thus show that a recovery of 99 per cent of the silver in the raw wastes is being obtained. The relatively high values of residual total cyanide in the supernatants from silver recovery may be at first glance surprising in view of the definite excess of chlorine which is used. The residual cyanide has been found to be due to the presence of iron cyanide complexes which are resistant to oxidation by hypochlorite. It will be recalled that the supernatant liquid from silver recovery is returned to the alkali sump and then follows through the main treatment scheme. The residual cyanide in the main waste streams is far less than would be estimated simply from the dilution of the silver recovery supernatant. It is believed that the iron cyanide complexes are pre-

TABLE IV. OPERATION OF ALKALI AND ACID WASTES TREATMENT SECTION

Tank No.	Date (1954)	Raw Waste			Treated Waste			Clearwell		
		Total CN p.p.m.	CNO p.p.m.	Gal. NaOCl	Total CN p.p.m.	CNO p.p.m.	Actual Excess Cl_2 p.p.m.	Total CN^- p.p.m.	Cu p.p.m.	Zn p.p.m.
1	2–15	88.1	4.6	358	2.03	9.2	13.5	0.07	.18	.00
2	2–15	8.8	72.0	168	1.69	2.2	5.7	—	—	—
3	2–16	21.1	4.5	92.5	1.17	—	3.8	0.26	—	—
1	2–16	19.8	2.8	83.8	0.78	—	6.4	—	—	—
2	2–17	25.0	0.0	93.5	0.20	5.5	9.2	0.09	.16	.19
3	2–17	21.7	5.6	99.5	0.77	0.4	20.0	—	—	—
1	2–17	16.9	56.3	144	0.68	1.7	10.7	—	—	—
2	2–18	25.2	2.1	104	1.63	—	8.5	0.32	.16	.04
3	2–18	18.5	4.4	82.1	0.88	1.4	9.2	0.03	—	—
1	2–19	19.5	0.0	77.0	0.21	—	3.5	0.09	.18	.23
2	2–19	12.1	7.7	63.9	0.52	0.0	11.4	0.41	—	—

cipitated in the general treatment scheme, possibly as copper salts.

The data of Table IV fail to present the complete picture of alkali and acid wastes treatment in that the complications resulting from the presence of organic materials (soaps, kerosene, etc.) are not indicated. The alkali wastes are very dirty and cloudy in appearance, and the treatment must provide not only for removal of potentially toxic materials such as cyanide and heavy metals but also for removal of suspended matter. The data of Table IV indicate very successful removal of the cyanide and heavy metals. The water in the clear well is ordinarily a clear sparkling liquid with a total cyanide content of 0.1–0.3 p.p.m., a copper content of 0.2 p.p.m., and a zinc content of less than 0.2 p.p.m.

Acknowledgments

In order to carry out the development of waste treatment facilities described in this paper within a period of less than three years it was necessary that the capable assistance and enthusiastic cooperation of numerous people be obtained. The authors are particularly indebted to Paul Eichenlaub and James Cox of the Works Laboratory at Sherrill for their considerable assistance; to John Madden of Westcott and Mapes for his very capable direction of the project in the layout and construction phases; to Walter Zabban, Raymond W. Southworth, and E. P. Heslin of the Department of Chemical Engineering, Yale University, for their part in the laboratory and pilot plant phases of the development; and to Louis Meites of the Department of Chemistry, Yale University, for his part in the analysis of raw wastes and treated wastes for heavy metals. The background information on cyanide oxidation which resulted from the participation of some of us in AES Research Project No. 10 was of particular value. This background information was a major influence in the choice of a process, as will be evident from this report.

DISCUSSION

Mr. I. Wm. Marcovitch (American Machine and Metals, Sellersville, Pa.): Our company is faced with a problem of disposing of various wastes, consisting of chromates, acids, and cyanides. What was the approximate cost of the plant described here?

Dr. Dodge: I can give you some very rough figures. It all depends on what one is talking about; if one goes back to the original start of this project, that is, back to the use of ponds, the overall development including the present plant, cost something in the order of $1,000,000. The actual present plant, with the development and engineering, and including all the equipment for final completion of the project that was started three years ago, cost about $750,000.

Mr. Peter L. Veit (Gumman Aircraft, Long Island, N. Y.): Were ion exchange techniques considered for the treatment of metal and cyanide waste before installation of this setup?

Dr. Dodge: Well, ion exchange was not very feasible for this type of waste. We have done work on ion exchange, and it appears to be good for certain types of wastes. Nearly every case of waste disposal is a special case. Ion exchange has been used particularly on recovery of chromic acid wastes, but I don't know

of any successful application to cyanide waste. We did some laboratory work, and it looked somewhat promising; but we have not done enough to be certain that it would work out on a large scale.

DR. L. R. LANCY (Consulting Engineer, Ellwood City, Pa.): What would have been the economical problem with a waste treatment job of this nature if the plating operations had been cyanide zinc plating instead of cyanide silver plating? That is, the economics of the question are somewhat different.

DR. DODGE: That is true. Of course, none of these processes can be expected to recover values equal to the cost of the process. The case of silver is an unusual one. It pays to recover the silver, and one does get a fair return on the operating cost. In the case of zinc, that probably would not be true. That would be the main difference in the economics.

DR. LANCY: May I amplify my question? Would you say that the plating process could not be carried on at this particular location because it would not be economical to maintain the plating department where you have to provide waste treatment similar to what was shown?

DR. DODGE: I cannot answer that. I know very little about plating, and that gets into the question of plating itself.

A. T. PATTERSON (Patterson Plating, Toronto, Ontario, Canada): How much silver in dollars was recovered per year?

DR. DODGE: I don't remember. I would say 99 per cent of all silver was recovered, but I don't have the actual figure in mind.

MR. PATTERSON: I thought that since we are dealing with silver and if you recovered, say in round figures a half-million dollars of silver a year, your answer would give us a better perspective on the whole disposal plant. That was the reason I wanted to introduce the reclamation returns per year.

MR. FREDERICK BAUCH (Frigidaire Division, General Motors, Dayton, O.): How permanent is this equipment and how high would be maintenance per year on a plant of this type?

DR. DODGE: This is something we can answer better ten years from now. Any answer now would be only a guess, based on results with other disposal plants using similar equipment.

* * *

Creation of new understandings, new principles, new products, and new services is industrial research. To these ends about two billion dollars is spent yearly, utilizing roughly one-fourth of all our engineering and scientific manpower. Research today is big business and, from all indications, is getting bigger.

* * *

A low cost system of using radioactive isotopes in industry has been developed to peer into dense materials with a new gamma ray machine. Produced by Gamma Industries, Baton Rouge, La., the machine reveals flaws and improper structural composition in steel plate up to 8 inches thick.

* * *

A versatile electrode for joining dissimilar high nickel alloys has been developed by Eutectic Welding Corp., Flushing, N. Y. It is said to be excellent for joining austenitic stainless steel to nickel or inconel, or cast alloys to steel.

* * *

An industrial research and development survey to be conducted by the National Science Foundation will develop data on research personnel, expenditures for research personnel, expenditures for research and their relation to corporate sales and invested capital, and on the amount of capital invested in research facilities. An attempt will also be made to discover how companies determine the size of their research programs, how they appraise returns, and the effect of taxes on industrial research. The entire inquiry, covering studies of research in all types of organizations, is expected to be completed by 1955.

Stock piles of basic research facts will never be used up. Newton's laws of motion, Einstein's relativity theories, and other scientific milestones always will be useful in practical technology. Researchers are, however, concerned with enlarging these foundations by still more basic research as they contemplate an ever-growing field of applied and industrial research.

* * *

Central America plans to open a long-considered institute of Industrial Research and Technology early next year. The institute is being set up as part of the Central American Economic Integration program of the United Nations, in furtherance of which Costa Rica, Honduras, Nicaragua, Guatemala, and El Salvador have submitted technical assistance requests.

* * *

Arctic ice, snow, and soil samples are being studied under simulated arctic conditions by engineers at Snow, Ice, and Permafrost Research establishment, Wilmette, Ill., in a program to improve military operations in Alaska, Greenland, and other far-Nogth places.

* * *

Electrodeposited coating thicknesses are measured by three new types of instruments developed at the National Bureau of Standards. The instruments depend on the difference in electrical conductivity between plating and basis metal. The *dermitron* and *phase-angle thickness meter* utilize electromagnetic couplings to the specimen, making use of reflected field from eddy currents induced in the specimen. The *wave-guide inspection tool* employs direct conductivity measurement with point electrodes.

THE TECHNOLOGY OF LIQUID BUFFING COMPOSITIONS*

ROBERT V. TWYNING†

The technology of liquid buffing compositions is a study in colloids, which subject has entertained the minds of some of the greatest physicists and chemists such as Kruyt, Helmholtz, Einstein, Debye, Langmuir, Freundlich, Zsigmondy, and Guoy over the past eighty years. It is advisable in the study of colloids that we revert to the academics of this branch of chemistry and differentiate between the two types of particles, suspensoids and emulsoids. Both emulsoids and suspensoids are sols and differ from each other tremendously in their physical behavior. The viscosity of a suspensoid solution varies only slightly from water itself, i.e., 5 per cent, while the viscosity of an emulsoid varies tremendously, so much so that the addition of as little as ½ per cent of natural or synthetic gums will raise the viscosity sufficiently to become immeasurable. The addition of minute amounts of electrolytes to a suspensoid causes precipitation, while emulsoids are affected only slightly but will coalesce upon the addition of sufficient quantity of electrolyte, especially that containing the di or trivalent cations. Suspensoids which have precipitated are in many cases not redispersable and in other cases only with great difficulty, while emulsoids which have coalesced can be regenerated easily. The stability of a suspensoid is dependent strictly on its electric charge (i.e., silica and gold sols being negative) and having lost its given charge precipitation occurs, while emulsoids have either a positive or negative electric charge and in some cases none at all (positive charge in acid solutions, negative charge in alkaline solutions). The effect which causes emulsoids to be inherently stable becomes evident when we consider that starches and gums undergo swelling in the presence of water. Hydration of such materials is a natural function, and the forces involved by their nature tend to keep the particles from coalescing. Suspensoids are continuously in vigorous motion while emulsoids show no sign of motion when sighted through an ultra microscope.

The Greek terms used to denote the physical actions of the elements within a molecule having properties bearing on emulsification are hydrophobic (meaning water hating), hydrophilic (water loving), liophobic and lypophobic (solvent hating), and liophilic and lypophilic (solvent loving). When the term liophobic colloid is used, reference is made to a suspensoidal particle wherein water is the dispersing medium but the suspended particles such as metals and/or their oxides have little or no affinity toward water. In the original Greek *lyo* meant "to loosen," and it becomes clear that liophilic when used as a synonym for emulsoid refers to starches and gums which hydrate readily and "love to loosen" and become disaggregated. As stated above, the elements within a molecule which are termed hydrophilic are normally one of the following polar groups, namely, hydroxyl, amine, carbonyl, mercapto, carboxyl, and functional groups of condensed ethylene oxide; hydrophobic elements are the nonpolar paraffinic or olefinic chains, in some cases containing even condensed propylene oxide within the hydrophobic element.[1]

The function of an emulsifier is twofold, namely, to allow for ready preparation of the emulsion and also to control the type that is formed, whether oil-in-water or water-in-oil. The emulsifier reduces the inter-facial tension of the two immiscible phases, thereby making the emulsion easy to prepare. Inter-facial tension is the numerical difference between the surface tension of two liquids to be emulsified. Water at 73 dynes per square centimeter and oil at 45 dynes per square centimeter have an inter-facial tension of 28 dynes. The function of the emulsifier is to reduce this 28 dynes to one or two dynes per square centimeter. If inter-facial tension measurements are made after the emulsifier has reduced the value to one or two dynes per square centimeter then it is found that the error introduced by the addition of the third phase (platinum ring) is in such magnitude as to give unreliable results.

All genuine vigorous emulsifiers are micro hetero-

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geneous and are colloidally dispersable. They must be heterogeneous in order not to be highly soluble in either the dispersed or continuous phase. Their elements must be of such composition as to cause the molecule to be partially, but not totally, soluble in each phase. When this requirement is met the molecules are then vigorous and accumulate at the inter-facial boundary of the dispersed phase. Fatty soaps are of this nature and have been our most prominent emulsifiers. It is interesting to note here that charcoal and soot have been used as emulsifiers just as effectively as fatty soaps; however, it is imperative to add that carbon in its various allotropic forms yields a positively charged suspensoid and that poor stability results if carbon is co-dispersed with finely divided siliceous abrasives which have an inherent negative charge. Advantage can be taken of the existence of this condition when, in the formulation of a solid or bar type buffing composition, it is found necessary to neutralize the extremely high electrostatic charge of the fine ends of tripoli powder (tripoli powder has the greatest dipole moment of all finely divided siliceous materials) which attach themselves electrostatically to the surface of buffed metal after the cleaning operation, whether it be chlorinated solvent or aqueous.

Emulsions are invariably formed in the hot state since the surface tension of water at 90°C is 61 dynes per square centimeter as against 73 dynes at 20°C; also the viscosity of both oil and water is a linear function of temperature, water losing 70 per cent of its room temperature viscosity at 90°C, i.e., one poise at 20° reducing to 0.31 poise at 90° and animal oil losing 90 per cent of its room temperature viscosity at 100°, i.e., 0.42 poise at 30° reducing to 0.046 poise at 90°. The above reductions in viscosity and surface tension account for the ease with which emulsions are made at elevated temperatures.

Emulsions are either water-in-oil (w/o) or oil-in-water (o/w), depending primarily on the selection of an emulsifier. Fatty soaps containing monovalent cations yield o/w emulsions. Fatty soaps containing bi and trivalent cations yield w/o emulsions. Emulsifiers which are strong in hydrophilic elements (polyoxethylene) yield o/w emulsions and conversely emulsifiers strong in hydrophobic elements (mono and di esters) yield w/o emulsions. Water content is not critical regardless of which type emulsion is desired, namely, o/w or w/o, but if the water content is not within reasonable limits the continuous phase can become discontinuous; in other words, the emulsion may invert from o/w to w/o in emulsions containing a deficient amount of water in the order of 10 to 20 per cent instead of the nominal amount of 50 to 60 per cent. The determination of which phase is continuous is not difficult. The most common method being to determine whether water acts as a diluent; if so, obviously water is the continuous phase. However, some emulsifiers are sufficiently vigorous so that either of the following two methods must be used: (1) the addition of an oil or water soluble dye and (2) the conductance of an electric current showing water to be continuous.

In 1820 Brown, an English botanist, first discovered that matter in a finely divided state when suspended in water was in violent agitation, which has since been termed Brownian movement. In 1879 the great physicist Helmholtz theorized that each particle in Brownian movement must be surrounded by a layer of adjacent anions which were again enveloped by an equal number of cations. The potential across this rigid double layer as hypothesized by Helmholtz was denoted as sigma, Σ, which is the transverse potential of the rigid double layer. In 1910 Guoy and Freundlich theorized that a portion of the cations as described by Helmholtz must be in the mobile liquid and ascribed a potential to these mobile cations only as a "zeta (Z) potential" and referred to them as a tangentical potential. The character of the transverse potential curve Σ, of which the tangentical potential curve Z is part, is dependent on the concentration of the electrolyte and valence of the ions; as these latter two increase, the potential and the double layer thickness decrease until precipitation occurs.

From the foregoing it appears that suspensoids are much more difficult to process than are emulsoids and fortunately protective colloids can be employed which envelope the suspensoids and their double layers, causing the suspensoids to behave exactly as an emulsoid thereby tolerating the electrolytes formed by the hydrolysis of the salts and hydrates present in the abrasives (the combined RO and R203 in Rose tripoli powder averages 4.6 per cent and the white cryptocrystaline silicas 0.25 per cent).

Zsigmondy determined the relative strength of certain negative protective colloids and defined his "Gold Number" as the number of milligrams of dry material of the emulsoid sol (protective colloid) which is just sufficient to prevent the change from red to blue in 10cc of gold sol, after the addition of 1cc of a 10 per cent sodium chloride solution. The reciprocal of the Gold Number is the "U Number" which readily conveys the comparative effectiveness of the colloids.

Protective Colloid	Gold Number	U Number
Gelatin	0.005	200.00
Isinglass	0.01	100.00
Casein	0.01	100.00
Gum arabic	0.15	7.00
Gum tragacanth	2.00	0.50
Dextrose	15.00	0.07
Starch	25.00	0.04

An interesting and significant research project[2] employing the turbidimetric method to determine the approximate particle size average in individual emulsions shows very close agreement with the average particle size as determined by means of the electron microscope.[3] The turbidimetric method utilizes a Parr

Instrument Type S-3 visual turbidimeter which measures the "extinction path length"; or depth of the solution through which a light source just fails to be visible. By means of the electron microscope the authors[4] determined the particle size by extrapolating data pertaining to an emulsion of Carnauba wax, borax, and fatty soap (excluding waters for dilution and to make the emulsion), 0.0765 microns for a 10.3 per cent solution of soap and 0.0685 microns for a 11.9 solution of soap. It appears that the minimum, and also the optimum, particle size for a fatty soap emulsion of Carnauba wax lies between 0.06 and 0.075 microns.

Bolton and Marshall, by means of a visual turbidimeter, made the following determination from emulsions of an oxidized paraffinic wax, oleic acid, and morpholine; the particle size increased with decreasing oleic acid additions over a wide range of morpholine additions, the particle size decreased as the oleic acid increased even though the morpholine additions were at a lesser percentage. From these data it is concluded that the sensitivity of a system to added morpholine is decreased with decreasing oleic acid and that relatively more morpholine is required for emulsification as the oleic acid is decreased, and also that the particle size is decreased greatly as the oleic acid increases and morpholine decreases.

Electron micro photographs of an emulsion by Schoenholtz and Kimball show the effect on the dispersed phase of using an excessive, a deficient, and the optimum amount of an amine emulsifier to gain minimum particle size. An excessive amount of amine causes the formation of agglomerates of such a large, irregular and random shape that one quarter of the visible field is heavily shadowed. A deficient amount of amine yields an entirely different type dispersion which consists partly of the spherical emulsoidal particles but contains mostly an unusual amount of anisotropic or crystalline lattices appearing as twisted ribbons and in some cases like finely dispersed fibrils none of which have similar configurations. The optimum amount of amine causes a dispersion which is associated with the normal concept in that the dispersed particles are, in some cases, truly spherical and some slightly elliptical, some spheres appear to have nodes attached but this may be due to one sphere partially underlying another and appearing as an appendage due to the dimensional aspect of a photograph. It is significant to relate here that the normal concept of metathetical reactions as between oleic acid and an amine do not hold true in dealing with colloids as is shown above, and which confirm further the literature,[5] which states that "simple stoichiometric relations no longer exist between the added substances."

It is of paramount importance that the components in the oil phase and the emulsifiers used in making the emulsions in which abrasives are suspended, produce soils which are adapted to the method of cleaning; for example, soluble fatty soaps are excellent emulsifiers but are insoluble in organic degreasing solvents; such soaps are readily removed by aqueous soak, spray wash, and electro cleaners. Surface active agents are very excellent emulsifiers, certain of them are cleanable in every cleaning method used prior to electro deposition; and are unique in that certain of them solubilize oils, fats, and waxes with the exception of sterols. These highly complex alicyclic alcohols and their esters are among the finest wax type lubricants known but also one of the most difficult to clean when in the form of buffing soil. Certain of the more common phosphatides are used as emulsifiers and also assist the more vigorous emulsifiers, however, they hydrolyze to form quatenary bases,[6] which are cationic and can cause cleaning difficulty because of the incompatibility of anionic and cationic surface active agents. The cleanability of liquid buffing composition soil is dependent, quite naturally, on its components but the quantity of soil is equally important; large amounts of easy cleaning soil are apt to leave patterns under plate if the buffed work is excessively loaded with soil. Such heavy soil removal is not a linear function of cleaning time and operators should beware of extreme soil loading. Solid or bar type compositions for nonferrous metals contain approximately 30 per cent binder, while liquid compositions contain approximately 40 per cent binder. This 10 per cent increase, which is further accentuated by the accompanying 10 per cent drop in abrasive powder, would seemingly cause liquid compositions to transfer more soil to the buffed work; however, the evaporation of the water from the buffing head cools the fabric very noticeably causing the grease face to become firmer and/or the fabric to become more rigid and therefore wipe the soiled work to a higher lustre than in the case with bar compositions; also, the water wets the cotton fibrils which have a higher tensile strength wet than dry.[7] Cotton is unique among the linear polymers in that it is one of the very few exhibiting this property.

Trichlorethylene degreasing solvent has been replaced by perchlorethylene where more stubborn soils require greater heat and greater solvency for their removal.[8] Mr. J. Hensley[9] and coworkers have used carbon C-14 tagged stearic acid as a soil applied onto highly polished steel discs finished with No. 220 silicon carbide in order to determine the effect of cleaning time with various singly used alkalis. In the course of their work it was found that 0.8 microgram of stearic acid on steel would wet perfectly and take a satisfactory bright nickel plate. This amount of soil, if assumed to be evenly distributed, and assumed that the surface were perfectly smooth and the effective and macro surfaces were equal, would be four molecular layers thick or 10 millimicrons. However, it cannot be stated arbitrarily that a certain quantity of soil will have a specified effect on the wettability of the metal surface or the nature of the electroplate applied over it.

The density of the silicas and the aluminas which are suspended in the emulsions are two to five times

greater than the emulsion density, and for the suspension to be free of settling obviously the emulsion must be stable and noncreaming (showing no sign of coalesced dispersed phase floating on the surface). The emulsion particle size should be reduced as far as possible (approximately 0.06 micron diameter) to attain this stability and protective colloids such as natural or synthetic gums can be used to raise the viscosity of the continuous phase to prevent settling.

Liquids are classified with reference to viscosity as Newtonian, Dilatant, or Thixotropic depending on whether they maintain viscosity independent of the speed of agitation, such as water or oil (Newtonian); whether they become more viscous on agitation, such as egg albumin or whipping cream (Dilatant); or whether they become less viscous on agitation such as Bentonite clay slurries and sols of iron oxide and aluminum oxide (Thixotropic). Liquid buffing compositions fall into this latter class, the name being derived from the Greek, *thixis*, meaning "touch," and *tropein*, meaning "to change." "Plastic Set" and Thixotropy are synonymous terms and refer to the "livered" or gelled condition of the liquid suspension. This pseudo gel is short lived, however, when the liquid is being pumped or in any way agitated and will develop again on standing. Because of the tremendous reduction in viscosity due to agitation inherent in pumping (a reduction from 12,000 cps to 6,000 cps is not uncommon) it is well to reduce proportionally the regulated pressure at the pump after a short period of recycle. The phenomenon called Thixotropy, which is beneficial when controlled in liquid buffing compositions since it prohibits the abrasive from settling on storage, is caused primarily by the solubilized salts and hydrates present in the abrasives. Thixotropy increases proportionally to the content of high melting components present in the dispersed phase of the emulsion when solvents are excluded; it also is a direct function of the alumina content of siliceous abrasives (Rose tripoli powder contains roughly four times the alumina as does Cream tripoli, while the more pure silicas contain half as much alumina as Cream tripoli).

The rate of metal removal by buffing or "cut" has been a relative term having no coefficient values except in the laboratory where preweighed brass discs work against each other in the presence of abrasive and mineral oil. A more significant laboratory testing device has a moving bed under a pressurized buffing head; however, in practice the criterion for cutting power rests with the operators and inspectors. The most satisfactory means for determining "cut" in the field is intentionally to coarse polish the base metal and follow with three or four passes of the buffing head at uniform pressure and equal elapsed time; the amount of coarse polish showing through the finish has proved quite satisfactory in determining comparative "cut." The cutting power of a liquid composition is very considerably dependent on how well the liquid "faces" the buffing head; almost invariably a faster cut is produced by a firm, hard wheel face for it is self evident that the abrasive must be firmly held by the wheel in order to cut. The success of liquid compositions in industrial application is due mainly to the attainment of a firm wheel face which is nearly synonymous with cutting power.

An ideal emulsion would be one that would split phase the instant it becomes atomized, to allow for free evaporation of water and cause the dispersed phase to coalesce onto the continuous grease face on the buffing head and also to prevent re-emulsification once the binder has split from the emulsion. Fortunately high vapor pressure emulsifiers are available which evaporate with the water and prevent re-emulsification on the wheel face. The water content of the emulsion should also therefore be just in excess of the critical for phase inversion so that even slight evaporation causes the dispersed phase to coalesce. The mono, di, and tri valent metallic oxides present in siliceous abrasives unfortunately cause gel formations which require additional water for dilution. The more pure hard-buffing abrasives now being marketed are sufficiently low in the above metallic oxides so as to allow the water content of the emulsion to approach the critical inversion point and thereby reduce the wheel throw off.

Before concluding it should be stated that the design and performance of the spray equipment has caused both failure and success of many liquid composition formulations; a change of spray gun design in the field has caused mediocre formulations to perform quite satisfactorily.

It is hoped that the information correlated in this discussion serves to enlighten those concerned and thereby add to the progress of metal finishing and electroplating.

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MR. LAVERNE VERZIER (Consultant, Waterbury, Conn.): Have you found too much effect from the impurities in the stainless steel cutting grades or stainless coloring grades on the stability of your emulsions?

MR. TWYNING: No, if the protective colloids are used to control viscosity of the continuous phase then the electrolyte formed by the soluble impurities does not cause precipitation of the suspensoidal particles since these particles then assume the same properties as the emulsoidal particles, but if the protective colloids are not used then the gravity of the abrasive being so much greater than that of the emulsion you get settling. However, in some cases we have had gas evolution from liquid stainless composition which is hard to explain.

MR. EDWARD HERZIG (Electro Tec Corporation, South Hackensack, N. J.): Can colloids be used to improve finish over regular type polishing compounds? If so, which of the liquid buffing types?

MR. TWYNING: Normally, in finishing nonferrous metals, the finish color of the metal is higher than when bar composition is used; this is so even though the liquid composition may contain 10 per cent more binder than bar type. It is probable that the water from the liquid type keeps the buff face cool and therefore firm.

MR. HERZIG: Are the particles of colloidal size?

MR. TWYNING: Of the abrasive?

MR. HERZIG: Yes.

MR. TWYNING: Oh, yes, they run from one-tenth to three-tenths micron diameter.

MR. HERZIG: So actually you cannot get a better finish.

MR. TWYNING: You can use the same abrasive in liquid composition as in bar and the finish will not be any different.

MR. HERZIG: What would be the proper type of equipment you have mentioned—is it buffing wheels or type of wheels?

MR. TWYNING: No, it is not dependent on the manufacture of the wheel or type of wheel. Normally, the bias construction buff is used on automatics where liquid compositions play the greatest part. It does not have to be all biased buff, many times piece buffs and bias buffs are put together 2-to-1 or 1-to-1.

MR. HERZIG: But what is the proper type of equipment which you have mentioned?

MR. TWYNING: Oh, pardon me—I see what you meant. The construction of spray equipment is quite technical and you almost have to become involved in this field to appreciate how technical it is; making spray equipment is involved and is quite an art and unless the equipment is proper and of rugged construction so that the vibrations inherent on an automatic machine do not tend to loosen the nuts and packings, you can have trouble. Spray guns should be rugged so that rough handling in use doesn't prevent proper performance. The airports in the wings of the air cap allow for pattern control which is vital costwise since overspray is wasteful. Proper gun design and performance are necessary in order to place all of the composition on the wheel face.

* * *

New transistor analyzer, small, lightweight, and portable between laboratories, was developed by Armour Research Foundation engineers. The instrument is used to measure directly the circuit constants of transistors while they are in operation.

* * *

Ceramic coating of extremely low thermal neutron absorption coefficient was developed by National Bureau of Standards for high temperature protection of alloys in nuclear reactors. Coatings were said to withstand thermal shock resistance tests involving quenching in water from as high as 2,000° F.

* * *

Battery operated survey meter for neutron measurement was developed for protection of personnel around atomic accelerators and reactors by Nuclear Instrument and Chemical Corporation, Chicago. Unit contains two neutron detectors, one for thermal neutrons, the other—surrounded by a block of paraffin and a cadmium shield—for "fast" neutrons with energies of more than 1 ev.

New surface anesthetic not only provides prompt relief from surface pain but also low toxicity and low sensitization, according to Abbott Laboratories, scientists who developed it. New drug, called *tronothane*, is said to afford unusual freedom from skin irritations often encountered with topically applied anesthetics.

* * *

A new welding electrode is said to provide better weld quality in inert-gas, shielded arc welding of aluminum, according to Aluminum Company of America. The new electrode also can be used for tungsten-arc welding where filler wire is fed mechanically to the work.

* * *

A simple method for producing furfuryl alcohol resin, invented by Erik R. Nielsen, senior chemist at Armour Research Foundation, provides for better and cheaper manufacture of plastic pipe, hot-melt coatings, and molding powders. Resin intermediate is formed quickly and smoothly by heating furfuryl alcohol in the presence of an activated alumina—without use of strong acid catalyst as was required formerly.

EFFECT OF ANODE COMPOSITION IN ACID COPPER PLATING*

R. P. NEVERS†, R. L. HUNGERFORD† AND E. W. PALMER†

One of the most perplexing and annoying problems confronting users of copper anodes in acid copper electroplating baths is the formation during electrolysis of anode sludge, consisting largely of tiny metallic particles of copper. These particles, in aggregate form, are carried by the electrolyte to the cathode surface, where some of them adhere and result in irregular growth and roughening of the deposit. If the electrolysis is continued long enough, rough nodules of appreciable size may be formed. This condition is often the factor that limits the thickness of deposit that can be acceptably produced. The problem is, of course, relatively unimportant where only thin or flash coatings are required, but it is extremely serious in electrotyping and electroforming operations.

A commonly accepted explanation[1] of the formation of the metallic particles is based on the presence in the anodic area of cuprous salts that become oxidized to the cupric form in a reaction in which metallic copper is also formed. In sulfate solutions it may be represented as:

Cuprous Sulfate $\longrightarrow$ Cupric Sulfate + Copper

$Cu_2SO_4 \longrightarrow CuSO_4 + Cu$

Another explanation[2, 3] for the particle formation is that they are very small crystal fragments freed from the anode during electrolysis by preferential attack at grain boundaries.

The authors favor the theory involving the reaction of cuprous sulfate to cupric sulfate plus copper, inasmuch as measurements of the individual particle size show that they average 0.001 mm in diameter. This is only one-twentieth of the diameter of the smallest grain size (0.020 mm) likely in a wrought (hot-rolled) anode and an even smaller fraction of the grain size of a cast anode. These fine particles are commonly observed as aggregates that sludge off and circulate in the electrolyte. A study of the individual particles in a sample of anode sludge dispersed under the microscope shows that they resemble in size and shape the copper

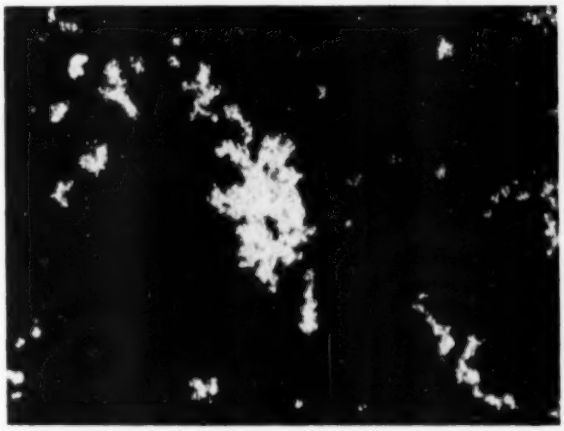

Fig. 1. Copper anode sludge. 425X

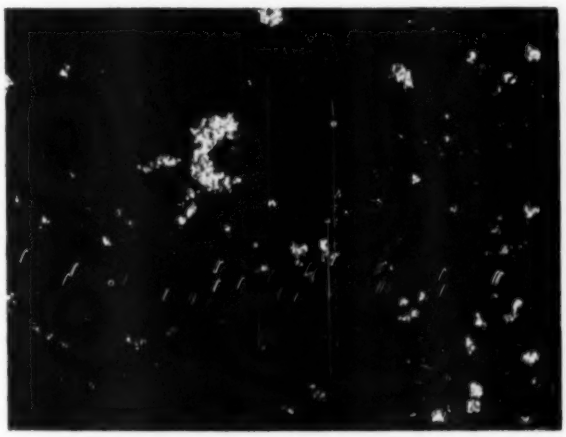

Fig. 2. Copper particles from action of sulfuric acid on cuprous oxide. 425X

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particles that are formed by the action of dilute sulfuric acid on cuprous oxide (Figs. 1 and 2). Fine particles of this type form on both cast and wrought anodes; but it should be pointed out that cast anodes do shed a small number of much larger particles that are indeed fragments of the anode and appear to come from the porous areas characteristic of cast anodes.

A common procedure for preventing the migration of anode sludge particles to the cathode surface is to envelop the anode in a bag made of linen, fine canvas, or glass cloth. Varying degrees of success have been obtained with this arrangement, but it is seldom satisfactory. In addition to the time and expense involved, the bag interferes with circulation of the electrolyte, causing uneven corrosion of the anode and resulting in higher scrap losses. The use of a tank deep enough to allow the sludge to settle below the work has been suggested, but this does not prevent particles going directly to the cathode from the anode in an agitated bath.

Data recently obtained from extensive experiments* show that when an anode is prepared from copper containing a small amount of certain elements it becomes coated during electrolysis with an adherent surface film that is dark brown to black, and the formation of metallic particles is completely suppressed. With such anodes a relatively thick cathode deposit may be obtained without the growth of nodules. (It is, of course, fundamental that no solid particles of any other kind should be permitted to enter the electrolyte.) Effective films are formed when either phosphorus or arsenic is present in amounts greater than 0.005 per cent. Several other elements form films of lesser effectiveness.

While the literature contains a number of articles emphasizing the necessity for the utmost purity in anode copper and stressing the importance of structure (fine grain), the present work has developed convincing evidence that structural variations in the anode, within the ordinary range, are lacking in any appreciable effect on the operation of the bath and that the presence of certain elements in the anode is highly desirable rather than deleterious. These conclusions stand, therefore, in direct contradiction to the customary beliefs.

The experimental work used a number of commercial grades of copper together with high purity copper containing various addition elements in controlled amounts. These coppers, chiefly in the wrought form, were studied as anodes in acid copper plating baths prepared in accordance with the following formula:

Copper sulfate ($CuSO_4 \cdot 5H_2O$)	28 oz/gal
Sulfuric acid	8 oz/gal
Chloride	trace (30 ppm hydrochloric acid)
Glue	11 ppm

Plating tests were made at room temperature in glass battery jars containing 7 liters (1.85 gallons) of plating solution. Cathodes were rolled-sheet copper suspended by copper wire or strip. The electrodes were spaced 3 inches apart and varied in size from test to test, the face of the smallest being $3\frac{1}{4} \times 1\frac{1}{4}$ inches and the largest, 6×6 inches. In most cases the anodes were not completely immersed. Anode current density, based on the facing area, usually was maintained in the range of 20 to 40 amp/sq ft. The electrolytes were agitated with air. The time of deposition ranged from 8 hours to 1 week of continuous plating.

In all tests using anodes of high purity, such as cathode copper or electrolytic tough pitch copper, the anodes soon developed a heavy coating consisting chiefly of the very fine copper particles described above. This coating was very loosely adherent, and aggregates of fine particles continually became detached, causing turbidity and forming layers of sediment. Any movement of the anode, however slight, dislodged more material. This was particularly noticeable upon withdrawing an anode from the bath, when clouds of copper particles slid off and floated away in the electrolyte.

That roughness of cathode deposits is caused by settlement of such tiny copper particles on the cathode surface was demonstrated in the following way. Sheet cathodes were bent so that the upper part of the face was exposed to the downward settling of particles, while the lower part was protected from such lodgement. Pronounced nodular growths occurred on the upward-facing surface only. The downward-facing surface, where no lodgement of particles due to gravity would be expected, was relatively smooth. Such roughness as did occur is evidence of the fact that fine particles circulating with the electrolyte may occasionally be captured even by protected surfaces.

Measurements of the weight gain at the cathode and weight loss at the anode show that as little as 85 per cent of the copper removed from anodes of high-purity copper is plated onto the cathode. The remainder is found partly as copper particles in the anode sludge and partly as increased copper sulfate in the plating bath. The dissolving power of the bath on the copper particles increases with agitation and aeration, and this action accounts for the typical build-up of copper sulfate in an aerated acid-copper bath.

A relatively impure, fire-refined, commercial copper performs anodically quite differently from the high purity coppers discussed above. The impure copper becomes coated in the early stages of a plating run with a dark-colored gelatinous film that is fairly adherent, although it does have some tendency to slide off as the anode is lifted out. In a prolonged deposition this anode coating begins to slough off to some extent, to form blackish woolly clumps that are easily broken and dispersed by vigorous agitation, as by aeration. Baths equipped with such copper anodes have a greatly diminished amount of turbidity and are almost free from wandering fine copper particles. There is no

*In the laboratories of the American Brass Company.

TABLE I

	Electrolytic Tough Pitch Copper		Fire-Refined Copper	Phosphorized Copper
	Aerated	Not Aerated	Aerated	Aerated
Anode loss (grams)	249.52	249.36	217.18	215.54
Cathode gain (grams)	213.38	213.74	213.03	212.91
Sludge or film (grams)	18.02	35.30	0.53	0.19*
Total copper in sludge or film (grams)	16.99	33.96	0.33	0.09*
Initial copper in electrolyte (grams)	311.11	309.93	311.34	310.34
Final copper in electrolyte (grams)	330.07	311.92	315.49	313.81
Distribution of copper as per cent of anode loss				
Cathode deposit	85.51	85.76	98.09	98.78
Sludge or film	6.81	13.61	0.15	0.04
Electrolyte gain	7.60	0.80	1.91	1.60

*Phosphorized copper forms no sludge, but only an adherent, nonmetallic anode film. Electrolytic tough pitch copper forms sludge.

doubt but that these characteristics account for the fact that cathode deposits from such anodes are definitely smoother than those from high purity anodes and that greater thicknesses of deposit are practical.

Cathode deposits from these relatively impure, film-forming, fire-refined anodes may average in weight as high as 98 per cent of the weight loss of the anodes. There is practically no anode sludge and, consequently, no appreciable build-up of copper in the solution.

The film-forming characteristics of this type of anode are unquestionably due to minor constituents in the copper. The analysis of the particular fire-refined copper used is as follows:

Copper	99.899 per cent
Oxygen	0.0422
Sulfur	0.0041
Selenium	0.0025
Tellurium	0.0013
Silver	0.0095
Arsenic	0.0049
Antimony	0.0014
Iron	0.0031
Nickel	0.0157
Bismuth	0.00004

Careful investigation has shown that in this particular copper, arsenic is the element chiefly responsible for the desirable characteristics of the anode film, although selenium, tellurium, and silver also aid in its development.

If fire-refined copper anodes contain suitable amounts of film-forming impurities, their use effects a marked improvement in acid copper plating technique. The desirable impurities in fire-refined copper are not, however, subject to control and vary in amount, even in copper from the same source; and there is relatively little fire-refined copper on the market. In addition, fire-refined copper anodes do not corrode as uniformly as might be desired. It seemed worthwhile to attempt the development of an anode copper of reproducibly superior characteristics, by adding to high purity copper the optimum amount of the elements found most desirable in film-forming characteristics and general anode behavior.

After extensive investigation, it has been concluded that wrought anodes made from high purity copper to which phosphorus has been added in suitable amounts (not merely enough to deoxidize the copper, but a definite excess of phosphorus) closely approach ideal behavior in acid copper plating solutions. Such anodes, containing 0.02 to 0.03 per cent of phosphorus, become coated during plating with a very thin, black film that has a surprising degree of adherence. There is no formation of copper particles during plating and the bath is as clear after prolonged use as when first started. The film is not disturbed by pulling the anode out of the bath and is so thin that no anode cleaning is necessary, though the film can be removed by brushing if desired. Careful measurements show that the presence

Fig. 3. Corroded anodes. 3/8 actual size
Phosphorized copper — *Fire-refined copper* — *Electrolytic tough pitch copper*

TABLE II

Plating Conditions (3 Cells in Series)

Anode	4 sq inches (3¼ by 1¼ inches)	Temperature	Room (72° F)
Cathode	8 sq inches (4 by 2 inches)	Current density	25 amp/sq. ft.
Electrode spacing	3 inches	Time operated	70 hours
Electrolyte	7 liters		

	C.C.C.* Copper + 0.02% Phosphorus	C.C.C. Copper + 0.002% Silver + 0.0014% Tellurium + 0.02% Phosphorus	Commercial Phosphorized Copper 0.02% Phosphorus
Anode loss (grams)	81.97	81.54	80.73
Cathode gain (grams)	79.57	79.54	79.53
Sludge or film (grams)	0.78	0.66	0.63
Cathode gain as % of anode loss	97.07	97.55	98.51
Loose copper particles in sludge or film	Definite	Scant	None

*C.C.C. copper is a very high purity commercial copper produced by the Chile Exploration Company at Chuquicamata, Chile.

of the film does not add resistance to the circuit and no additional voltage is required. Phosphorized copper anodes corrode uniformly and evenly, with remarkably smooth surfaces as compared with the rough, uneven, undercut surfaces usually observed for high-purity copper and even for fire-refined copper (Fig. 3).

The relative anode behaviors of electrolytic tough pitch, fire-refined and phosphorized coppers are indicated in Table I. These data were obtained on a run in which the cells containing the various anodes were operated in series, and have been established as typical by repeating the inter-comparison several times under varying operating conditions. The general superiority of the phosphorized copper anode is unquestionable. About 15 per cent of the electrolytic tough pitch anode is lost mostly as sludge under non-aerated conditions, while with aeration about the same percentage is lost, being divided between sludge and build-up of copper in the electrolyte.

The percentage of anode loss recovered on the cathode when phosphorus-bearing anodes are used is even greater than that obtained from fire-refined anodes. The remainder of the anode loss of phosphorized anodes is found in the black film envelope and in the electrolyte. Analysis of a typical dried film, disclosed the presence of the following:

	per cent		per cent
Copper	52.42	Arsenic	0.16
Silver	9.99	Antimony	0.0
Selenium	1.49	Phosphorus	5.76
Tellurium	0.68		

The use of phosphor-copper to remove cuprous oxide when casting anodes is mentioned by Thews.[3] However, it is specified that only enough phosphorus be added to react with the oxide in the melt, any more than that amount being described as leaving phosphorus and phosphorus oxide products in the metal with resultant harmful effects to the electrolytic process. In the plating experiments carried on by the authors, it has been found that phosphorus in excess of the amount necessary for deoxidation is required to bring about the advantages described. Anodes containing less than 0.005 per cent phosphorus definitely contained too little, scarcely differing from electrolytic tough pitch copper in sludge-forming properties. On the other hand, a phosphorus-bearing copper anode containing as much as 0.04 per cent phosphorus formed a good film, free from any trace of sludge. Moreover, the cathode deposit obtained was of excellent quality. Still higher phosphorus contents it is believed will give equally good anode behavior, but these appear to offer no advantage; in fact, the heavier films formed may become detached and eventually build up on the bottom of the tank.

In some of the early experiments with phosphorized copper made from very high purity copper, it was found that the anode characteristics consistently were slightly inferior to commercial coppers. A careful study showed that certain elements commonly present in other commercial coppers, but substantially absent in the very high purity copper used as the alloy base, were also of some importance in determining anode behavior. Most important of these elements are silver, tellurium, and selenium. The amounts involved are very small. For example, it has been established that a copper containing 0.0006 per cent silver and 0.0008 per cent tellurium, as well as 0.025 per cent phosphorus shows a significant improvement over the high purity phosphorized material. With 0.002 per cent silver and 0.0014 per cent tellurium present, a synthetic copper closely reproduces the excellent behavior of commercial phosphorized copper of the same phosphorus content (Table II).

Copper anodes containing other deoxidants for copper, such as silicon, calcium, cerium, and boron—in excess of the amount required for deoxidation—sludged badly in use, indicating that the desirable anode characteristics are imparted by the phosphorus and are not

associated with the removal of oxides. For example, in a run using as anode a copper deoxidized with about 0.015 per cent boron, the cathode gain was only about 90.0 per cent of the anode loss, the difference appearing very largely as copper sludge. The fact that O.F.H.C. (Oxygen-Free High Conductivity) copper anodes soon become coated with copper particles and form a copper sludge, is further evidence that the mere absence of oxides, in a relatively high purity copper, does not ensure desirable anode behavior.

Grain size has long been considered to be of some importance in determining anode characteristics, with fine-grained anodes expected to give better deposits. In order to obtain information on this, plating was done using rolled copper anodes which had been annealed at a series of temperatures so as to obtain a gradation in grain size. Grain sizes on high purity copper were in the range 0.030–0.260 mm, and on phosphorized copper in the range 0.035–0.065 mm. No appreciable differences, at either anode or cathode, were noted.

Summary

Contrary to the prevailing belief that copper of the highest possible purity makes the best anode for acid-copper plating, it is shown that far superior anode characteristics can be obtained with coppers containing small amounts of certain definite addition elements.

These improved anode coppers are characterized by the fact that no anode sludge of metallic copper particles is formed during electrolysis. Since there are no copper particles, the solution remains clear and smooth deposits of any desired thickness may be obtained. Build-up of copper in the solution, caused by the dissolving of such particles by aerated electrolyte, is avoided. The absence of anode sludge, and the very smooth corrosion of the improved anodes, means that practically 100 per cent of the copper removed from the anode can be deposited on the cathode, as compared with as little as 85 per cent when electrolytic tough pitch copper anodes are used.

Some fire-refined coppers, by virtue of the presence of small amounts of certain impurities, particularly arsenic, are found to have desirable anode characteristics to a considerable extent. Because such coppers are fundamentally somewhat variable in the degree to which they possess such desirable characteristics, a new anode copper having controlled and reproducible characteristics has been developed by adding 0.02–0.03 per cent phosphorus to a commercially pure copper. Such anodes show practically ideal behavior, and it is believed that their many advantages will make them desirable for all acid copper plating, and practically indispensable where heavy copper deposits are required. Because of more complete utilization of the anode and because of savings in solution maintenance, the use of phosphorized copper anodes* should result in a significant reduction of copper plating costs.

Acknowledgments

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*U. S. Patent allowed.

DISCUSSION

Mr. Edwin R. Bowerman (Sylvania Electric Products, Inc., Flushing, N. Y.): Some time ago in doing copper electroforming we ran into the problem of roughness on the cathode that you mentioned and believed at that time that it was due to material sloughing off from the anode. We went over to the platinum anodes thinking that if we had no copper anode we could have no anode slime. We got the same kind of roughness, the same kind of particle formation in the bath with platinum anodes as we did with copper. This tends to confirm your reaction theory of the cuprous ion to form these particles with copper.

On the other hand, this poses a problem that you have not answered and that is what have you done to the anolyte by this anode that prevents the formation of the particles right within the solution? It seems to me that there is an unanswered question as to why you are able to prevent this reaction from occurring, which will occur with platinum but did not with your filmed anodes.

Mr. Nevers: As far as we know, there are a number of causes, perhaps, of rough growths on the cathode, certainly one of which is enlargement of solid particles, but there are also conditions of the electrolyte which permit this and I think we have had a paper at this convention giving evidence of that, but certainly as far as enlargement of copper particles is concerned this will prevent it. A good many growths are caused by that because we have observed the differences between the deposits obtained from electrolytic tough pitch copper and phosphorized copper and there are significant differences.

You refer to the anolyte—what do you mean? Something underneath this film, perhaps?

Mr. Bowerman: No, I meant the solution directly

adjacent to the anode. I realize there are many causes for roughness. We use diaphragm systems with good filtration and have our cathode in a separate compartment in order to prevent this roughness from forming. It seems to me you must do something in the anolyte to prevent the forming of cuprous ion, otherwise the particular mechanism you are referring to would occur regardless of the type of anode that you had. You have added something beyond the film on the anodes. You have added something in the solution to prevent this formation.

MR. NEVERS: I gave the composition of the solution which contains a small amount of chlorides and some gelatine, glue, but the mechanism that goes on behind the film I am certainly not acquainted with.

MR. A. L. BISIO (American Smelting and Refining Company, Central Research Laboratories, South Plainfield, N. J.): The acid copper plating bath used in these studies contained both glue and chloride ions. Gauvin and Winkler [J. Electrochem. Soc., *99*, 71–7 (1952)] have shown that the presence of chloride ion and glue causes increased formation of Cu powder at the anode. Using electrolytic tough-pitch copper in acidified copper sulfate solutions, with no additions of either glue or chloride, it is our experience that the quantity of sludge formed is rarely greater than 1 to 2 per cent of the anode loss. Have you investigated the effect of phosphorus in the electrolyte on addition agents such as thiourea in the G-M bright and semi-bright acid copper process as on the control of the impurities in the solution?

MR. NEVERS: Let me say this, that we have continued using these electrolytes for quite some time and some phosphorus does get into the electrolytes. We also know that in analytical work, for example, we can get an awfully good plating of copper in determining copper in an alloy containing 15 per cent of phosphorus. You try it some time.

MR. BISIO: No evidence other than a comparison of particle size was presented in reaching the conclusion that the sludge is wholly copper. Has the sludge been analyzed?

MR. NEVERS: Yes, we find that it is copper and nothing else.

MR. BISIO: Analysis of anode sludge from acid copper plating solutions has been found by our laboratories to be a mixture of copper powder and cuprous oxide. If the anode is phosphorized, the sludge which is formed will also contain phosphorus.

MR. NEVERS: We did not get any sludge with the phosphorized copper.

MR. BISIO: What about the film?

MR. NEVERS: I think it was something like 5.9 phosphorus in the film.

DR. WALTER R. MEYER (Enthone, Inc., New Haven, Conn.): Solid particles could form both at the anode and cathode. Formation of particles at the anode in acid solutions has already been discussed. At the cathode cuprous oxide can form at low current density areas where stagnation of solution occurs. The copper is reduced from the cupric to the cuprous state and if the *p*H is high enough it will precipitate as cuprous hydroxide. This condition can be readily observed when plating copper from a solution of the cupric ethylenediamine tetracetic acid complex.

MR. BARNET D. OSTROW (Lea-Ronal, Inc., New York, N. Y.): How does the phosphorus appear in the anode itself—beside deoxidizing the copper, does it have any specific change on the grain structure?

MR. NEVERS: It does, a little, as we have determined by its response to annealing temperatures. We know that it has a little effect. When we have phosphorus present at 0.02 per cent or 0.03 per cent, I presume there is a little of it in the form of phosphorus oxide because it is deoxided. There is also some present in the solid solution and also some present as copper phosphide.

MR. OSTROW: Incidentally, you would probably be interested to know that we had the opportunity to run some tests on bright acid baths using this phosphorus anode and we found that the anode sludge formation was very, very low and much better than the others.

MR. NEVERS: That is on high speed?

MR. OSTROW: That is on a bright acid copper bath only.

DR. E. LAUE (Mac Dermid Incorporated, Waterbury, Conn.): My questions have been partly covered. I suppose you have no ready explanation of what happens, how these films are being formed in acid solutions and perhaps in cyanide solutions. I wished that, if you do any more work, emphasis might be put on that. For instance, if you do have copper metal in contact with the anode, it remains to be explained why it does not dissolve.

In cyanide solutions, I think two things are being observed—there are complaints about roughness at high current densities, which can be more readily understood, and also complaints about roughness at very low current densities.

Could you offer any explanation?

MR. NEVERS: We have not attempted to observe the conditions at the higher current densities. As I said, we have operated at 25 to 40 asf on the facing area, that is, with one anode and one cathode and actually, I believe, we have gone as high as 50 asf. We have no ready explanation of the mechanism which forms this film, but we hope that it may prove to be a subject of research perhaps by some electrochemist at a later date.

MR. W. B. STEPHENSON (General Electric, AGT Division, Cincinnati, O.): I don't see why we should be so frightened of a little phosphorus in anodes, because for years we have been using probably 2 to 3 per cent carbon in our nickel anodes. However, there seems to be one question which has not been asked or discussed and that is, what is the composition of the cathode deposit? Have you done any work on that?

MR. NEVERS: Yes. We find no phosphorus in the cathode deposit.

aes research project 5

EFFECT OF IMPURITIES AND PURIFICATION OF ELECTROPLATING SOLUTIONS*

I. Nickel Solutions
8. The Effects and Removal of Lead

D. T. EWING,† J. K. WERNER,‡ C. J. OWEN,‡ W. O. DOW‡, AND R. J. ROWE‡

SUMMARY

The effects of small amounts of lead present in four types of nickel plating solutions on the appearance, adhesion, ductility, salt spray (fog) corrosion resistance, hardness, and throwing power of nickel deposits were studied. Watts nickel solutions of pH 2.2 and 5.2, nickel-cobalt, and organic nickel solutions were used. In general a tendency for all deposits to brighten occurs with increasing lead content. Adhesion remains unchanged. Ductility is not appreciably affected. An increasing lead concentration tends to increase slightly the corrosion resistance of the heavier deposits in the salt spray (fog) corrosion test. Removal of lead is effective using low current density electrolysis. A high pH precipitation is also effective, but at a pH of 5.8, the loss of nickel metal can become appreciable.

Introduction

The effects of lead as an impurity in four types of nickel plating solutions were studied and data are presented which show the accompanying changes in certain physical properties of the deposited nickel.

Since lead is frequently used in tank linings and plumbing in nickel plating installations, considerable work has been published concerning some effects on the properties of nickel deposits due to lead contamination. In the correlated abstract and critical review of the literature,[1] it was noted that the presence of lead in nickel plating solutions generally resulted in dark, streaked, nonadherent deposits. However some early investigators advocated the use of lead as an addition agent to achieve lustrous deposits which were also quite brittle. The methods of removal of lead as an impurity in nickel plating solutions by low current density electrolysis, or by high *p*H precipitation as lead sulfate are referred to in the above summary. Piontelli later advocated the removal of metallic impurities, including lead, by the use of powdered Raney nickel.[2] Case suggested the electrolytic removal of lead at 2 to 4 amperes per square foot (0.2 to 0.4 amp/dm^2), with agitation being an important factor in the rate of removal.[3]

In this investigation, lead was added as the impurity (in the form of lead chloride) to each of four representative nickel solutions. These solutions consisted of the Watts type *p*H 2.2 and 5.2, an organic type *p*H 3.2, and a nickel-cobalt type *p*H 3.75. The composition of these four nickel solutions and the standard procedures utilized throughout this investigation are to be found in an earlier publication of this series.[4] As the solubility of lead in nickel solutions is dependent upon several factors such as temperature, *p*H, and chloride concentration, equilibrium solubility tests were conducted to determine the gradients of lead concentration to be utilized. The room temperature solubility (as lead) in the Watts *p*H 2.2 solution was 17 mg/l; in the Watts *p*H 5.2, 22 mg/l; in the organic, 25.5 mg/l; and in the nickel-cobalt, 34.5 mg/l. The equilibrium solubility in each, at a temperature of 60° C (140° F), was 35.5, 35.0, 43.3, and 64.5 mg/l respectively. It should be pointed out that nickel solutions of differing compositions than those utilized in this investigation may have a greater capacity for lead concentration, especially those having a high chloride content.

The deposits obtained were analyzed qualitatively for appearance, adhesion, hardness, ductility, salt spray (fog) corrosion resistance, and throwing power. The properties of the deposits from the solutions containing varying quantities of lead were determined by comparison with those from lead-free solutions. Since trends were the objective instead of absolute data, deviations were reported as percent change from the properties of the pure deposit. Low current density electrolysis at 1, 3, 5, and 9 amperes per square foot (0.1, 0.3, 0.5, and 1.0 amp/dm^2) and high *p*H precipitation were also investigated as possible methods of lead removal.

Experimental

A. *Preparation of panels and evaluation of physical properties*

Purified nickel solutions were used throughout this investigation for the preparation of deposits for the evaluation of the various properties. Briefly, the purification of these solutions consisted of: (1) a high *p*H treatment with nickel carbonate to remove those metallic im-

*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, 15 July 1954.
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TABLE I. THE EFFECT OF LEAD ON THE HARDNESS OF NICKEL DEPOSITS*

Types of Nickel Solutions

Lead Conc. mg/l	Watts *p*H 2.2	Watts *p*H 5.2	Organic *p*H 3.2	Nickel-Cobalt *p*H 3.75
2.5	0.0%	−2.3%	−12.1%	0.0%
5.0	0.5	−4.6	− 9.5	10.3
10	−2.2	−6.5	—	12.3
15	4.5	—	−13.2	—
20	—	−8.3	—	3.3
25	—	—	− 1.2	—
35	—	—	—	8.4

*Based on per cent change in hardness from pure deposit.

purities at a *p*H of 5.6 to 5.8; (2) a low current density electrolysis for 100 ampere hours per gallon, utilizing a corrugated cathode giving a current density of 2 to 7 amperes per square foot; and (3) removal of the organic impurities by the addition of activated carbon (7.5 g/l). Detailed methods and procedures are to be found in the previous publications of this project.[4,6]

The impurity was added to each nickel solution in the concentration gradients shown in Table I. The lead content of the nickel plating solutions was determined colorimetrically by the method developed by the American Electroplaters' Society Research Project No. 2,[5] and modified by the Engineering Division of Chrysler Corporation. The samples were extracted with a carbon tetrachloride solution of dithizone in the presence of potassium cyanide to separate lead from the interfering ions. After removal of the excess dithizone with alkaline potassium cyanide, the transmittancy of the solution was measured with a Klett-Summerson colorimeter using a green (No. 54) filter and a 0.5 inch diameter cell. The scale reading was plotted against the known lead content to give the calibration curve. Samples from the plating solutions were subjected to the same analysis, the transmittancy reading was obtained with the colorimeter, and the lead content was interpolated from the calibration curve.

B. *Effects on physical properties*

1. Appearance—The evaluation of the surface appearance of the Watts *p*H 2.2 and 5.2 panels was achieved by comparison with the Eastman Gray Scale.[4,7] The evaluation of the surface appearance of the brighter deposits was more difficult. The classification range of dull to mirror bright was found to be insufficient for describing the appearance of the organic and nickel-cobalt deposit. However, in the absence of an accepted standard, all deposits were classified as mirror bright and the increase in brightness with increasing lead concentration was attributed to an observed decrease in visible base metal defects. The panels plated from the Watts *p*H 2.2 solution showed a slight brightening effect in the low current density area at the 5 mg/l lead concentration. This area increased in size and brightness with increasing lead concentration. The value of 1 to 2 was assigned to these deposits by comparison with the Eastman Gray Scale. The Watts *p*H 5.2 panels showed a similar brightening effect in the low current density area beginning at the 2.5 mg/l lead concentration and increasing in brightness and area with increasing lead concentration. The Eastman Gray Scale value of 1 to 2 was designated for these deposits.

An increase in lead impurity in the organic solution resulted in a decrease in visible base metal defects on the panels and an improved control over the brightener. This decrease in visible base metal defects gave a possible illusion of a brighter plate or increased reflectivity, depending on the definition of brightness. The nickel-cobalt panels exhibited a similar effect in covering base metal defects and in the case of brightener control at the higher lead concentrations. In addition there was a blackening in the very low current density area on the back center of the panels, beginning with the 20 mg/l lead concentration and becoming more pronounced on the 35 mg/l panels.

2. Adhesion—Horizontal panel sections plated from the four representative nickel solutions were subjected to the qualitative test approved for this determination.[4] This test consisted of bending each horizontal section longitudinally under pressure, upper side outward, and examining the bent edge under a 40 power microscope. Flaking was considered indicative of poor adhesion. The results showed good adhesion of the nickel deposit to the steel base metal in all cases.

3. Ductility—A 0.001 inch strip deposit of nickel deposited on the oxidized nickel surface of the panels was prepared from all solutions. The test consisted of bending and creasing two or three sections of each strip deposit repeatedly in both directions, using the same crease line, until failure occurred. The extent of bending and creasing of the deposits from the lead containing solutions was compared with that of the deposits from the pure solutions. The Watts *p*H 2.2 strip deposits showed a maximum increase in ductility of about 15 per cent at the 5 mg/l lead concentration followed by a decrease to a negative 10 per cent at the higher impurity concentrations, the upper limit being 15 mg/l. The Watts *p*H 5.2 deposits showed a very definite increase in ductility, beginning with 5 per cent at the 5 mg/l lead concentration and increasing to 50 per cent at the 20 mg/l concentration. The organic deposits showed a slight decrease in ductility of about 8 per cent at the 15 and 25 mg/l concentrations. No trend was observed for ductility in the nickel-cobalt panels with increasing lead impurity.

4. Hardness—The hardness measurements were made with a TuKon hardness tester at the National Bureau of Standards. A deposit of 0.002 inch thickness was utilized for this evaluation. The results are presented in Table I as per cent change in hardness from that of a pure deposit. In general, the nickel deposits with the exception of those from the nickel-cobalt alloy solution exhibit a decrease in hardness upon the addition of lead. An increase of 12 per cent in hardness developed in the nickel-cobalt solution at a lead concentration of only 10 mg/l. Some hardening occurred in the Watts *p*H 2.2 deposits due to a lead concentration of 15 mg/l.

5. Salt Spray (fog) Corrosion Resistance—Following the procedure set forth in ASTM Specification B 117-49T and using the system of rating described in a previous paper,[4] the change in corrosion resistance of the deposited nickel due to the presence of lead in solution was evaluated. The deposits were subjected to salt spray and were compared with ASTM panels No. 11 (before breakdown), No. 9 (at breakdown), and No. 7 (after breakdown). This gave a standardized procedure for the evaluation of this property. The test specimens were unbuffed nickel plated steel panels. Three thicknesses of deposits—0.0003, 0.001, and 0.0015 inch—were made in groups of three at each concentration of lead used. Prior to the exposure test, the deposits were cleaned with magnesium oxide paste to remove surface film. The results are reported as per cent change from the breakdown time of the standard deposits made from pure solutions.

The effect of lead as an impurity in nickel plating solutions upon the salt spray corrosion resistance are shown in Figs. 1, 2, 3, and 4. In general the presence of lead increased the corrosion resistance of the heavier deposits of nickel from the four types of solutions. The 0.0003 inch deposits exhibited a slight de-

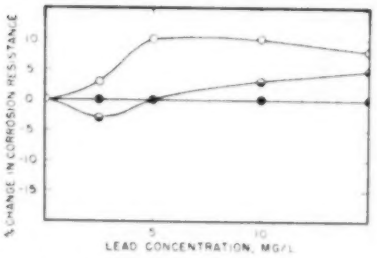

Fig. 1. Effect of lead concentration on the salt spray (fog) corrosion resistance of varied thickness deposits from a Watts 2.2 pH solution
○ *0.0003 inch deposit*
◓ *0.0010 inch deposit*
● *0.0015 inch deposit*

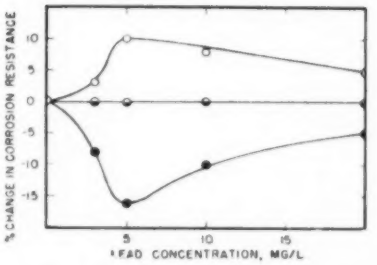

Fig. 2. Effect of lead concentration on the salt spray (fog) corrosion resistance of varied thickness deposits from a Watts pH 5.2 solution
● *0.0003 inch deposit*
◓ *0.0010 inch deposit*
– *0.0015 inch deposit*

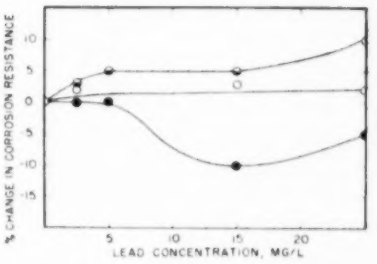

Fig. 3. Effect of lead concentration on the salt spray (fog) corrosion resistance of varied thickness deposits from an organic type solution
● *0.0003 inch deposit*
◓ *0.0010 inch deposit*
○ *0.0015 inch deposit*

crease in corrosion resistance or no change in the trend.

6. Throwing Power—The throwing power determination consisted of a microscopic measurement of plate thickness of the 0.002 inch bent cathode horizontal sections. The cross-section of the upper plate thickness only was examined with a Bausch and Lomb Metallographic Microscope. Comparison of these measurements with those of the samples deposited from the pure solutions gave a measure of the throwing power. It was assumed that, since no gassing was observed at the cathode in any solution, any deviation in deposit thickness was due to a change in throwing power and not current efficiency. The results of the investigation of throwing power are summarized in Table II. The Watts *p*H 2.2 and 5.2 deposits showed a slight decrease in throwing power with increasing lead concentration while the organic deposits showed a slight increase. The throwing power of the nickel-cobalt solution exhibited an initial increase of 8 per cent at the 2.5 mg/l concentration, decreased to a negative 3 per cent at the 10 mg/l concentration, and then increased to over 12 per cent at the 35 mg/l level.

C. *Removal of Lead*

1. Procedure—The removal of lead was accomplished by a low current density electrolysis and a high *p*H precipitation. Low current electrolyses were conducted at current densities of 1, 3, 5, and 9 amperes per square foot (0.1, 0.3, 0.5, and 1 amp/dm²) for each of the four solution types in order to clarify the inconsistency of the recommended optimum for lead removal. These were carried out at the operating temperature with an agitation rate of 4 ft/min past the cathode. Removal of lead by high *p*H precipitation was conducted according to the standard method, additions of nickel carbonate being used to raise the *p*H. The solutions were analyzed periodically for lead concentration.

Removal at the operating current density of 40 amperes per square foot (4.3 amp/dm²) was also studied in order to obtain the data necessary for maintaining the solutions at the specific lead concentrations. In these depletion determinations at the operating current density, a liter of each type solution containing the maximum concentration of lead chloride was operated continuously. Samples were taken at various time intervals and analyzed for lead concentration. These results were plotted against time. In order to maintain the lead concentration at the desired levels, a lead chloride solution of 5 mg/l lead concentration was added periodically to the solutions used for preparing the test panels. These additions were made after 10 per cent of the lead concentration at each gradient had been removed during deposition, as determined from the depletion rate curves. Depletion rate curves are shown in Fig. 5.

2. Evaluation of Results—The low current density removal of lead from the Watts *p*H 2.2 solution at current densities of 1, 3, 5, and 9 amperes per square foot is shown by the curves in Fig. 6. A lead concentration of about 2.5 mg/l, an assumed optimum, is reached by the electrolysis of the solution under the following conditions: 1 amp/sq ft after about 6 hours (1.2 amp hrs/gal), 3 amp/sq ft after 10 hours (or 6 amp hrs/gal), 5 amp/sq ft after 9 hours (or 9 amp hrs/gal), and 9 amp/sq ft after 9 hours (or 17 amp

TABLE II. THE EFFECT OF LEAD ON THE THROWING POWER OF NICKEL SOLUTIONS
Types of Nickel Solutions

Lead Conc. mg/l	Watts *p*H 2.2	Watts *p*H 5.2	Organic *p*H 3.2	Nickel-Cobalt *p*H 3.75
		Per cent Change		
2.5	−1.4%	0.5%	−1.2%	8.0%
5.0	−0.9	−1.2	0.0	6.8
10	−3.1	−4.2	—	−3.0
15	−5.9	—	1.7	—
20	—	−5.2	—	0.0
25	—	—	2.3	—
35	—	—	—	12.2

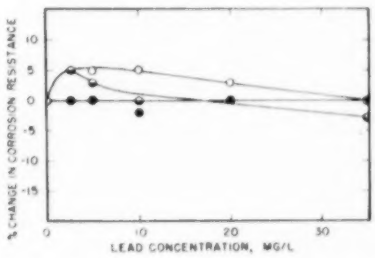

Fig. 4. Effect of lead concentration on the salt spray (fog) corrosion resistance of varied thickness deposits from a nickel-cobalt alloy type solution
● *0.0003 inch deposit*
◓ *0.0010 inch deposit*
○ *0.0015 inch deposit*

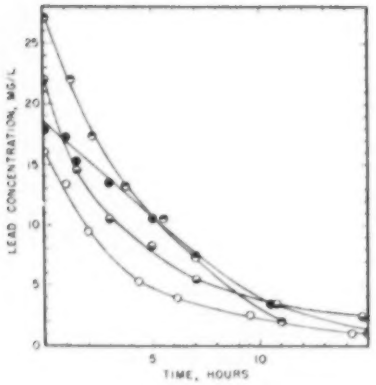

Fig. 5. Depletion rates of lead from nickel solutions under operating conditions
○ *Watts pH 2.2 bath*
● *Watts pH 5.2 bath*
● *Organic bath*
● *Nickel-cobalt bath*

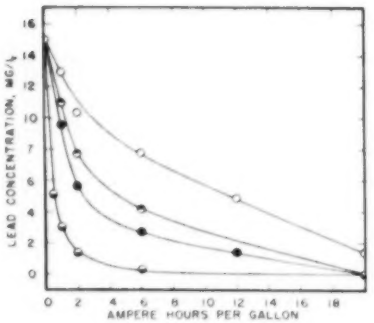

Fig. 6. Effect of low current density electrolysis on the lead concentration in a Watts pH 2.2 bath
● *1 ASF bath*
● *3 ASF bath*
● *5 ASF bath*
○ *9 ASF bath*

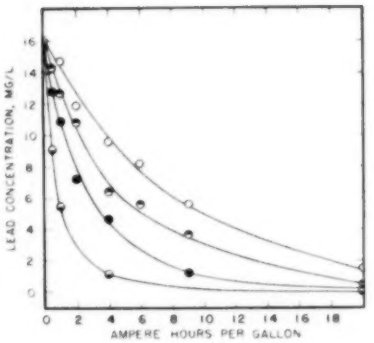

Fig. 7. Effect of low current density electrolysis on the lead concentration in a Watts pH 5.2 bath
● *1 ASF bath*
● *3 ASF bath*
● *5 ASF bath*
○ *9 ASF bath*

hrs/gal). Thus for the Watts *p*H 2.2 solution the 1 amp/sq ft is the best current density to use for removal of lead as the time is the least. The amount of nickel expended would be directly proportional to the amp hrs/gal and would constitute an additional factor qualifying this choice. It is noted that the amount of lead removed on electrolysis at the different current densities is nearly the same per unit of time. However, this amount varies for each of the four solutions.

Figure 7 shows the curves for the low current density removal of lead from the Watts *p*H 5.2 solution. A lead concentration of 2.5 mg/l was reached after 10 hours (or 2 amp hrs/gal) with 1 amp/sq ft, after 10 hours (or 6 amp hrs/gal) with 3 amp/sq ft, after 12 hours (or 12 amp hrs/gal) with 5 amp/sq ft, and after 9 hours (or 16 amp hrs/gal) with 9 amp/sq ft. Again, as in the Watts *p*H 2.2 solution, the 1 amp/sq ft current density appears more practical because only one-eighth as much nickel is consumed (as compared with the 9 amp/sq ft) and the time for removal to the assumed optimum is nearly constant.

In Fig. 8 the low current density removal of lead from the organic type solution is shown. The assumed optimum lead concentration was reached after 9 hours (or 1.8 amp hrs/gal), with 1 amp/sq ft, after 10 hours (or 6 amp hrs/gal) with 3 amp/sq ft, after 8 hours (or 8 amp hrs/gal) with 5 amp/sq ft, and after about 12 hours (or over 20 amp hrs/gal) with 9 amp/sq ft. The curves indicate that the 1 amp/sq ft current density is best because of the saving of nickel and time.

The lead removal from the nickel-cobalt alloy type solution is shown in Fig. 9. The lead concentration of 2.5 mg/l is reached with 1 amp/sq ft after 20 hours (or 4 amp hrs/gal), with 3 amp/sq ft after 20 hours (or 12 amp hrs/gal), with 5 amp/sq ft after 16 hours (or 16 amp hrs/gal), and with 9 amp/sq ft after 11 hours (or 19 amp hrs/gal). The choice of current density for the removal of lead lies between time or nickel, whichever is the least expendable.

The high *p*H precipitation of lead by nickel carbonate from the four representative nickel solutions is shown in Fig. 10. The curve for Watts *p*H 2.2 solution shows that the lead concentration may be diminished to about 2 mg/l when the *p*H reaches 5.8, but above this nickel is also precipitated. The Watts *p*H 5.2 curve shows that the lead concentration does not diminish to about 2 mg/l until a *p*H of 6.2 is reached. The curve for the organic type solution shows that the lead concentration becomes about 2 mg/l at a *p*H of 5.4. In the nickel-cobalt solution the concentration of lead cannot be made less than about 7 mg/l at a *p*H of 5.7. The *p*H limit reached in all solutions was the maximum attained with nickel carbonate. No visual loss of nickel was noted except possibly in the two Watts solutions.

Conclusions

The results of this investigation of the effects of lead as an impurity in four different types of nickel plating solutions may be summarized briefly as follows:

An increasing lead concentration produced a general brightening effect on the deposited metal. This was more noticeable on the Watts *p*H 2.2 and 5.2 panels in the low current density area. In the absence of an accepted standard, the brightening of the organic and nickel-cobalt panels was attributed to a decrease in visible base metal defects with increasing lead concentration. In the latter two solutions there was also improved control over the brightener with increasing impurity.

Adhesion was unaffected by increasing the lead concentration. In all cases the adhesion of the deposit to the base metal was good and no flaking of the deposit was observed.

The ductility test on the strip deposits showed no general effect on ductility of the nickel with the exception of the Watts *p*H 5.2 deposits, where a definite increase in ductility with increasing lead concentration was observed.

A decrease in hardness of the nickel deposits was measured upon the addition of lead to the nickel solutions, with the exception of those from nickel-cobalt solution which showed an increase in hardness.

The salt spray corrosion resistance of the 0.0003 inch, 0.001 inch, and 0.0015 inch panels from the four representative solutions was only slightly affected by increasing lead concentration. No deviation was greater than 10 per cent other than the 0.0003 inch Watts *p*H 5.2 panels, where a 15 per cent decrease in corrosion resistance was noted at the 5 mg/l concentration. The thinner 0.0003 inch deposits exhibited either a slight or no decrease in corrosion resistance. The 0.001 inch deposits were either unaffected or a slight increase in corrosion resistance resulted. The 0.0015 inch deposits showed a slight increase in corrosion resistance with increasing lead concentration.

Little effect was observed on the throwing power with the exception of the nickel-cobalt solution in which the throwing power proved erratic as the lead concentration was increased. The throwing power of the Watts solutions decreased slightly and that of the organic solution increased slightly with increasing impurity.

Removal of lead by low current density electrolysis was generally more effective at the 1 amp/sq ft current density. The saving in nickel justified this choice

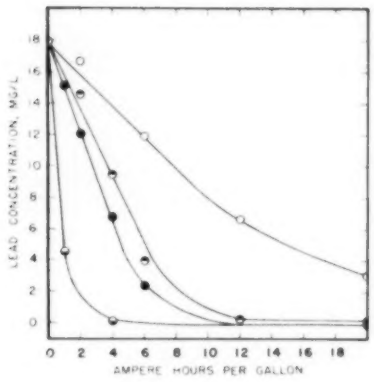

Fig. 8. Effect of low current density electrolysis on the lead concentration in an organic type solution
- *1 ASF bath*
- *3 ASF Bath*
- *5 ASF bath*
- *9 ASF bath*

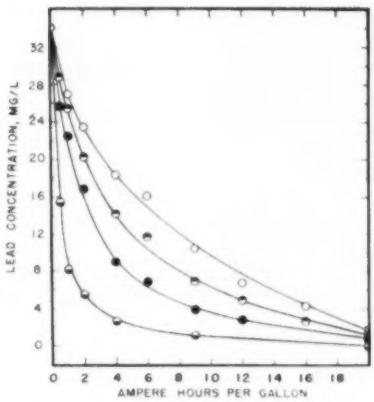

Fig. 9. Effect of low current density electrolysis on the lead concentration in a nickel-cobalt alloy type bath
- *1 ASF bath*
- *3 ASF bath*
- *5 ASF bath*
- *9 ASF bath*

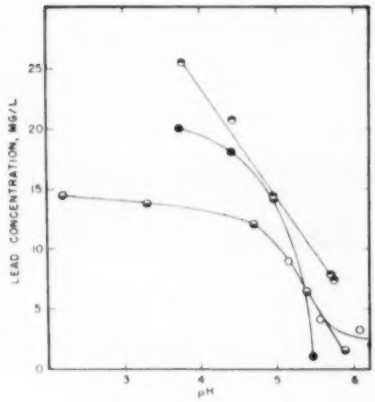

Fig. 10. Removal of lead from nickel solutions by high pH treatment
- *Watts pH 2.2 bath*
- *Watts pH 5.2 bath*
- *Organic bath*
- *Nickel-cobalt bath*

for the Watts solutions, since the time for removal to the optimum was nearly a constant regardless of the current density used. For the nickel-cobalt solution, the choice was between expending time or nickel. If time was more valuable, the higher current density should be used with consequent higher nickel consumption. The 1 amp/sq ft current density was the qualified choice for the organic bath because less time was required to remove the lead to the optimum concentration and much less nickel was used.

High *p*H precipitation was also utilized in removing lead from the four solutions. With the exception of the nickel-cobalt solution, the assumed optimum of 2.5 mg/l of lead could be attained without the appreciable loss of nickel. This loss occurred above a *p*H of approximately 5.8. The lead content of the nickel-cobalt solution could not be removed below a concentration of 7 mg/l by high *p*H precipitation.

Acknowledgment

Acknowledgment is due the Research Committee: Mr. Cleve Nixon, General Motors Research, District Supervisor; and the Project Committee, L. C. Borchert, Houdaille-Hershey Corporation, Chairman; Mr. H. A. Kafarski, Ford Motor Company and Mr. Lee Morse, Chrysler Corporation, for their contribution to this project.

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DISCUSSION

Dr. Dodd S. Carr (Bart Laboratories Company, Inc., Belleville, N. J.): The presence of lead in a nickel plating bath tends to cause embrittlement when heated. I wonder whether you have data on the minimum amount of lead that would cause embrittlement of the nickel deposit when it was heated? I am thinking now of nickel plated steel which would be welded with nickel welding and the tendency for cracking in the nickel near the weld due to the excess heat.

Dr. Ewing: I am sorry, but we do not have data of those kinds. We did not analyze the panels for the amount of co-deposited lead and no heat treatment studies were made.

Dr. Carr: I don't know how prevalent the practice is of heating nickel deposits, I mean in the sense of welding, but it is a point, I know, to have a deposit that is free of lead for welding applications and I thought it might be well to include that type of data in a report of this nature.

Dr. Ewing: We do know that lead is rapidly removed from the solution electrolytically and therefore is incorporated in the deposit even at operating current densities of 40 amperes per square foot. I have a graph here which illustrates high current density removal and it will be incorporated in the publication. At 40 amperes per square foot the lead is removed quite rapidly, although not as efficiently as it is at the low current densities, but it is definitely incorporated in the deposit.

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Book Review

DR. HAROLD J. READ

Professor of Metallurgy.
The Pennsylvania State University

INSTRUMENTAL ANALYSIS by John H. Harley and Stephen E. Wiberley, 1954, vii + 440 pages. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price, $6.50.

Analytical control has been an extremely important part of scientific and technical progress in metal finishing. Within the field of analysis the increased use of instrumental methods has reduced greatly the cost and manpower requirements of routine analyses. In some instances instrumental methods have made practical analyses that would be hopelessly expensive or time consuming when executed by traditional methods. It is evident, therefore, that metal finishers should have more than a passing interest in a textbook devoted to instrumental analysis.

The volume under review is a reasonably satisfactory attempt to present in a general way the elementary theory of instrumental analysis and to describe the actual equipment that is available at the present time. The book is quite comprehensive, it is relatively easy to read, and it is up-to-date in almost every respect.

The authors have based their selection of instruments to be described on the apparatus available in the laboratory at Rensselaer Polytechnic Institute. This might seem like a rather arbitrary approach and one which would leave many gaps in the listing of equipment. It seems, however, that the authors' laboratory is extraordinarily well equipped. The only apparent serious omission is the recording spectrometer, an instrument which is becoming very important as a routine method for emission spectrography. About the only other criticism which occurred to the reviewer was that the relative amounts of theoretical and practical material vary considerably from one chapter to the next. The chapter on *p*H determination, for example, contains a far greater ratio of theory to practice than the other chapters in the volume, and it is theory that is available in any elementary analytical text. A minor objection is the loose use of certain words and terms, for example, "gamma" and "contrast," which are not *exactly* the same, are used interchangeably in the discussion of the photographic process. The authors should respect the meanings of "per cent" and "percentage."

On the whole the book should give the reader a general idea of the instruments available for specific analytical problems. The possibilities as well as the limitations of each instrument are well presented. Although there are some references to the literature, the book is not a complete guide in this respect.

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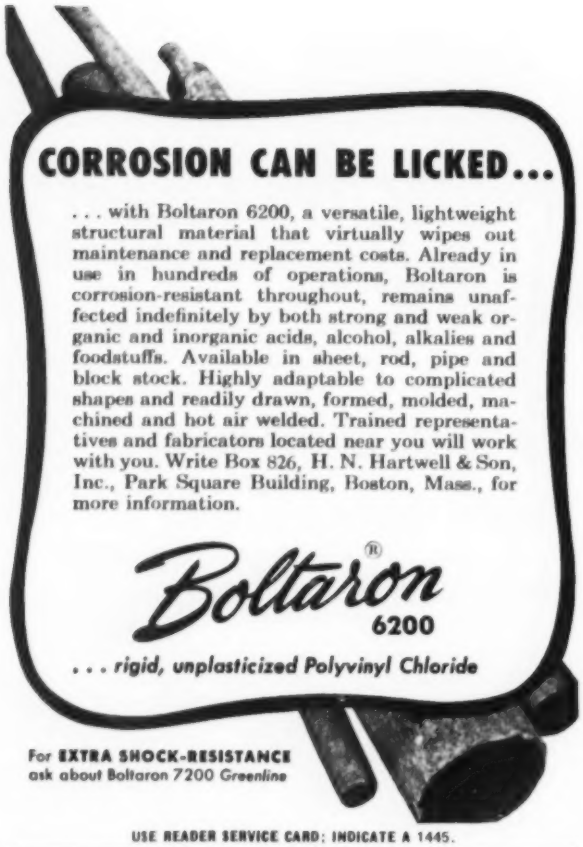
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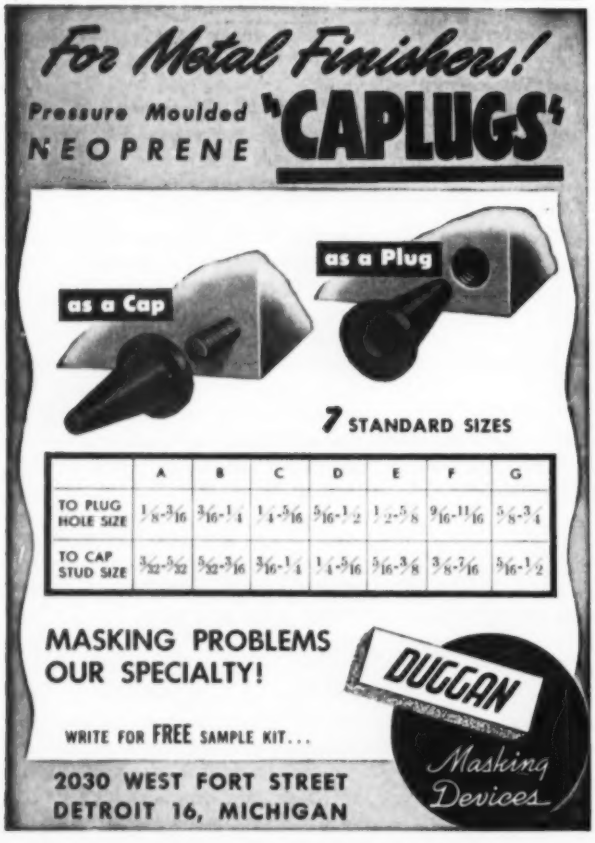

	A	B	C	D	E	F	G
TO PLUG HOLE SIZE	1/8-3/16	3/16-1/4	1/4-5/16	5/16-1/2	1/2-5/8	9/16-11/16	5/8-3/4
TO CAP STUD SIZE	3/32-5/32	5/32-3/16	3/16-1/4	1/4-5/16	5/16-3/8	3/8-7/16	5/16-1/2

Article Abstracts

No copies of articles are available at the offices of "Plating." Photostats may be had from libraries having files of the journal in question and offering photostat service, usually at 30-50 cents a page. Ask your public library to consult the Union List for names of libraries having the particular journal. Abbreviations used are those of Chemical Abstracts.

Electropolishing with Rectified Current. J. Steiner. Metalloberflache **6**, B65 (May 1954).

The influence of the waviness of rectified a-c (single phase half-wave and full-wave, three-phase half-wave and full-wave) on the brightness obtained by electropolishing of copper, brass, aluminum, and stainless steel in various electrolytes is reported. A small amount of waviness of the rectified current has no or a slightly favorable effect, more waviness (increased a-c component) may have a favorable or unfavorable effect depending on conditions. Considerable waviness has a bad influence on throwing power, especially in electrolytes characterized by low throwing power.

Protection of Metals against High-Temperature Oxidation. O. von Goldbeck. Metalloberflache **8**, A83 (June 1954).

A survey on the application (from melts, gasses, by sintering, cladding, spraying) of metallic (Cr, Ni, Al on steel and molybdenum steels), nitride, carbide (e.g., titanium nitride or carbide), oxide and silicate coatings for high temperature applications is given.

Chromium coatings must have a certain minimum thickness, otherwise they increase the rate of high temperature oxidation of steel.

Titanium nitride (T-N) on steel has very good adhesion, is very hard, and is very corrosion resistant at room temperature, but oxidizes above 500° C.

Oxide and silicate coatings give the best temperature resistance, e.g., alternate coatings of zirconium silicate and aluminum oxide on molybdenum and steel, and molybdenum silicide ($MoSi_2$) coating on molybdenum wire.

Metalizing of Nonconducting Materials. F. Elser. Metalloberflache **8**, A107 (July 1954), and **8**, A126 (Aug. 1954).

This article is a survey report on (1) the physical properties of various plastics (before and after metalizing), (2) treatments prior to metalizing; (3) the various methods of metalizing (chemical reduction from aqueous solutions of silver, copper, acid, burning-in on ceramics, vaporizing in vacuo, spraying), and (4) special plating solutions for reinforcement of the initial metal film.

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LSI-10	100 gal/hr	12" x 16" x 16"	40 lb
ASI-300	300 gal/hr	2' x 2' x 2'	125 lb
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ASI-600	600 gal/hr	2' x 2' x 2'	150 lb

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Article Abstracts

Hard Bright Silver Deposits. L. Bosdorf and A. Beyer. Metalloberflache **6**, B113 (Aug. 1954).

The authors discuss the increased hardness of bright silver deposits (100–140 kg/mm² Vickers of bright silver as compared to 40–70 kg/mm² for matte silver), present surface photomicrographs, mention periodic-reverse plating, and report in detail on the advantages of bright silver deposits in the electrical industry.

Direct Titration of Zinc and Cadmium in Cyanide Baths. C. Mahr and H. Otterbein. Metalloberflache **6**, B117 (Aug. 1954).

Data are given on titration of zinc and cadmium with disodium ethylenediamine tetraacetate, Eriochrome Black T serving as an indicator, after destruction of the cyanide with formaldehyde. This method differs only in details from the one given by J. P. Leftin in Metal Finishing **52**, No. 4, 74 (April 1954).

Mechanical Properties of Aluminum Hard Coatings. H. A. Johnson. Product Engineering **25**, 136 (Sept. 1954).

Increased hardness and wear resistance are important advantages of hard coatings on aluminum, but both fatigue resistance and tensile strength are reduced—enough to influence design, or even restrict the use of these coatings from some applications.

New Process Electroplates Nickel Directly on Aluminum. S. G. Bart, Can. Metals **17**, No. 6, 42 (1954), C. A. **48**, 9237 (Aug. 1954).

The outlined process requires no intermediate bonding materials and establishes a good bond. A stress-free, ductile, and pore-free surface can be applied to any thickness.

Double Layer in Anodic Oxidation of Aluminum. C. C. Guardia, Afinidád (Spain) **30**, 188 (1953). Al. Lab. Abst. Bull. **25**, 535 (Aug. 1954).

Anodic oxidation in boric acid of aluminum sheets previously covered with a porous oxide layer is beneficial since more rapid formation of the dielectric film is obtained, and the film is of improved quality and has less residual current than that from aluminum not previously covered. The utilization of lower grade aluminum in condensers is thus made possible. The theoretical aspects of the phenomena are discussed, and it is suggested that the dielectric film is reorganized from one already formed during the earlier oxidation and hence only a proportion of new material is required and greater velocity of formation is attained.

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Patent Abstracts

DR. D. GARDNER FOULKE

Manager, Electrochemical Development
Hanson-Van Winkle-Munning Co.
Matawan, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,676,146—Differential Meter—G. H. Rendel, assignor to U. S. Steel Corporation, April 20, 1954.

An apparatus is described for determining the relative thickness of tin coating on opposite sides of a continuous moving strip without using a totalizing shunt. See U. S. Patent 2,603,595.

2 claims, 1 figure.

No. 2,682,500—Process of Preparing Pressure Molds and Dies—L. S. Tanner, assignor of half to A. Lindinger, June 29, 1954.

A method is claimed for providing a prestressed die for use in pressure molding by electroforming a negative face of the part to be formed in the die of nickel, iron, or chromium (shell), depositing a flash coating of copper on said shell after which it is repositioned on the replica and backed with molten metal (bronze, beryllium-copper, etc.) under pressure to knit backing and shell and stress shell and backing, after which the replica is removed.

1 claim, 9 figures.

No. 2,682,501—Preparation of Two-Sided Mosaic—G. K. Teal, assignor to Bell Laboratories, June 29, 1954.

A method is claimed for forming a two-sided target by mounting an apertured metallic screen tightly against a support plate, insulating the exposed surfaces of the screen after which the support plate is removed to expose one side of the screen, which is then made nonconductive. The section first insulated is made conductive in an approved fashion and then plated to yield protruding plugs on both sides of screen, after which the insulating material is removed to provide a screen structure for use in television tubes.

2 claims, 10 figures.

No. 2,632,502—Method and Material for Electrolytically Brightening Aluminum—F. H. Hesch, assignor to Kaiser Aluminum and Chemical Corporation, June 29, 1954.

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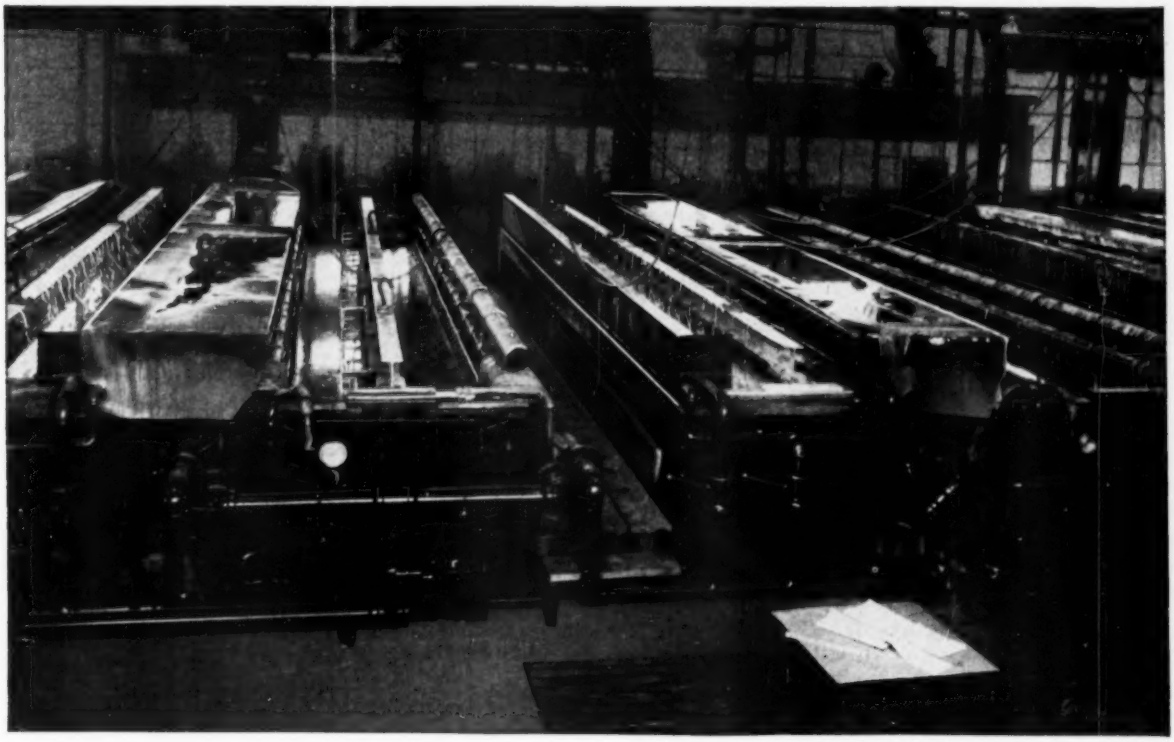

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Patent Abstracts

An anodic brightening process is claimed for aluminum and alloys thereof employing an electrolyte consisting of 0.1–0.8 per cent HF, 0–2.0 per cent H_3BO_3, 0.05–0.5 per cent CrO_3, and the balance water. The temperature is 100°–212° F and a current density of 10–80 asf is disclosed, either a-c or d-c. The transparent coating may be sealed by immersing the article, on which the transparent oxide coating has been formed, in water at 160–210° F. Polyhydric alcohols such as glycerol may be present in small amounts (1/2–4 ml/l). 5 claims.

Patent 2,682,503, also issued to Mr. Hesch, describes an electrolyte consisting of an aqueous solution of HF, 0.1–0.8 per cent; sulfamic acid, 0.05–0.4 per cent; and chromic acid, 0.3–2.1 per cent. 4 claims.

No. 2,682,702—Carbonyl Metal Plated Product—A. O. Fink, assignor to the Commonwealth Engineering Company, July 6, 1954.

A multi-layer metal product which is resistant to blistering and separation of layers wherein an aluminum base metal receives a 0.00001–0.00025 inch coating of nickel more porous than the aluminum using a gaseous carbonyl. A second layer od nickel, also formed by deposition from nickel carbonyl, greater in thickness and higher in density than the first is then laid down.

A number of similar carbonyl plating patents have also been issued recently: **2,685,121** to O. Davis et al (Aug. 3, 1954) on metal film formation; **2,685,124** to H. A. Toulmin, Jr. (Aug. 3) on hi-vac alloying and coating; **2,685,532** to P. Pawlyk (Aug. 3) on gas plating with chromium hexacarbonyl; and **2,685,535** to H. Hack on an apparatus for the deposition of materials by thermal decomposition (Aug. 3).

No. 2,683,112—Method of Electroplating—H. J. Reindl and S. R. Prance, assignors to General Motors Corporation, July 6, 1954.

A method for plating a steering wheel having a metal core covered with plastic material, by inserting metal pins through the plastic and flush with it to the metal core, then metallizing the plastic as desired, and electroplating by making cathodic through the metal core.

3 claims, 4 figures.

No. 2,683,113—Method of Finishing Ice Trays—S. R. Prance and H. J. Reindl, assignors to General Motors Corporation, July 6, 1954.

A method is claimed for making waxed and colored aluminum ice trays in which the steps are as follows: cleaning, chemical brightening, anodizing, dyeing the anodic coating, and sealing.

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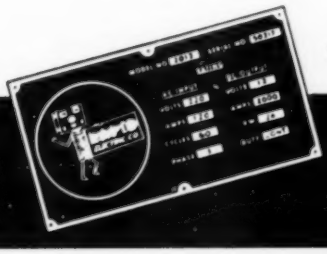

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Patent Abstracts

In all steps above the surface must be protected continuously by an aqueous film. The tray is then dried and in a hot, fluid wax-like material to protect the dye and render the tray surface water and ice repellent.

2 claims, 2 figures.

No. 2,683,114—Electrodeposition of Antimony—John D. Little, assignor to Harshaw Chemical Company, July 6, 1954.

A process for plating adherent, lustrous deposits of antimony on lead is claimed from an acid aqueous solution containing antimony ions and addition agents such as benzene sulfonamide, dibenzene sulfonamide, and toluene sulfonamide (0.5–0.6 g/l) and diphenyl or triphenyl guanidine (0.005–0.07 g/l). Other claims describe the bath as containing antimony trifluoride (1.25 mols/l disclosed) at a pH of 2.5 and the use of citric or oxalic acid. Claimed also for lead, tin, silver, alloys thereof, and rough steel.

9 claims.

No. 2,683,115—Electrodeposition of Nickel—A. H. DuRose and Karl Willson, assignors to The Harshaw Chemical Company, July 6, 1954.

The use of formaldehyde is disclosed as extending the operable life of coumarin containing nickel plating solutions. A bath is claimed consisting of nickel ions, coumarin, and its substitution products (0.05 g/l to saturation) and formaldehyde (0.1–0.4 gm/l at a pH of 3.0–5.0.

15 claims.

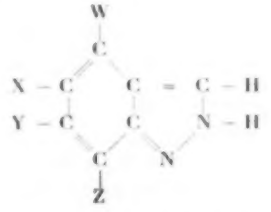
No. 2,683,687—Anodically Polishing Zinc Surfaces—R. M. Wick, assignor to Bethlehem Steel Company, July 13, 1954.

A process for anodically polishing zinc surfaces by electrolyzing in an aqueous solution of chromic acid (250 g/l) and boric acid (12 g/l) at a current density of 150 asf at a bath temperature of 70–90° F for not less than 10 seconds.

8 claims.

No. 2,684,327—Bright Nickel Plating—Frank Passal, assignor to United Chromium, Inc., July 20, 1954.

A bright nickel plating solution is claimed containing a nickel salt, a secondary brightener of the aryl sulfonate type, and a primary brightener of the indazole type (0.005–0.05 g/l). The basic formula is:



and derivatives are claimed in which W, X, Y, and Z may be radicals such as amino, nitro, hydroxy, or oxy-hydrocarbons, etc.

14 claims.

No. 2,684,328—Treatment of Silver to Inhibit Tarnishing—C. F. Matthews and J. C. Sawyer, assignors to Oneida, Ltd., July 20, 1954.

A process is claimed for inhibiting the corrosion of silver and silver alloys whereby the silver article is immersed in an aqueous solution of a fluoborate of a metal more electropositive than silver for a period of time insufficient to deposit a visible detectable layer of said metal on the silver. Other claims cover stannous fluoborate (1–9 per cent) specifically, and describes a cathodic treatment in such a solution (2 asf disclosed). Fluoboric acid and lead, chromium, nickel, cobalt, cadmium, indium, and zinc fluoborate are mentioned in the disclosure.

12 claims.

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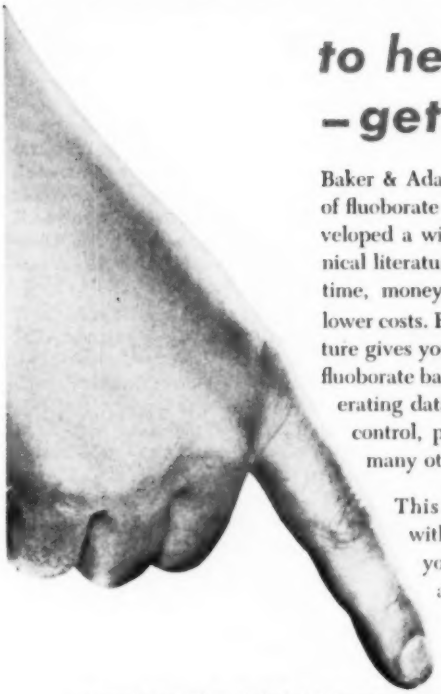

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☐ TA-36431 Copper Plating From the Fluoborate Bath
☐ TB-36431 High Speed Forming of Electrotype Shells
☐ TC-36431 Plating of Baby Shoes
☐ TD-36431 Plating of Plastics
☐ TE-36431 Plating of Rotogravure Cylinders
☐ TF-36431 Manufacture of Sound Records
☐ TG-36431 Plating of Printed Circuits
☐ RA-36431 "Copper Plating From Fluoborate Solutions," reprinted from "*The Monthly Review*," official organ of the American Electroplaters Society, September, 1946.
☐ RB-36431 "Copper Fluoborate Plating Experiences," reprinted from "*The Electroplaters and Stereotypers Magazine*," June, 1953.

Ferrous Fluoborate

☐ TA-37641 Iron Plating of Stereotypes
☐ RA-37641 "Iron Plating Curved Stereotypes From a Fluoborate Bath," reprinted from "*The Electrotypers & Stereotypers Magazine*," July, 1952.

Fluoboric Acid

☐ TA-30691 Applications in Metal Finishing

Indium Fluoborate

☐ TA-37991 Indium Plating From Fluoborate Solutions

Lead Fluoborate

☐ TA-38351 Lead Plating From the Fluoborate Bath
☐ TB-38351 *Lead-Tin Alloy Plating From the Fluoborate Bath
☐ TC-38351 *Lead-Tin Alloy Plating in Electrotyping and Other Applications
☐ RA-38351 *"Metal Coatings Improve Solder Flow on Steel and Brass," reprinted from "*Materials & Methods*," May, 1949.
☐ RB-38351 *"Solderability of Lead-Tin Alloy Plating," reprinted from "*Iron Age*," December 8, 1949.

Nickel Fluoborate

☐ TA-40221 Barrel Plating
☐ TB-40221 Plating Stereotypes
☐ TC-40221 Plating Upon Aluminum
☐ RA-40221 "Barrel Plating with Nickel Fluoborate," reprinted from "*Plating*," October, 1950.
☐ RB-40221 "High Speed Nickel Plating of Curved Stereotypes," reprinted from "*Electrotypers & Stereotypers Bulletin*, March, 1950.
☐ RC-40221 "Nickel Plating From Fluoborate Solution," reprinted from "*Plating*," December, 1950.

Tin Fluoborate

☐ TA-43441 Tin Plating From the Fluoborate Bath
☐ TB-43441 Plating of Electrotype Shells
☐ TC-43441 Electrotinning of Copper Wire.

See Also Articles Marked*.

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The Exposition Committee, under the chairmanship of LEON R. WESTBROOK, consultant; and the Convention Committee, headed by E. L. COMBS of Diamond Alkali Company, with headquarters in Cleveland, are already busy with their plans to make this 1955 gathering the best and most productive in the long history of the Society.

An indication of the wide interest in the event is the report from HAROLD E. BARTLETT and ALBERT W. ERICKSON, from the management staff of American Decorating Company, that more than two-thirds of the selling space in the auditorium has already been taken by exhibitors.

Of equal interest is the report that the exhibitors who have contracted for this space are planning colorful new and novel displays that will emphasize the importance of electroplating and industrial finishing to the visiting sales-minded executives and engineers in the field.

With all sessions of the Society to be held under the same roof with the Industrial Finishing Exposition, the convenience and ease of attendance at technical sessions scheduled to permit plenty of time for visiting the adjacent exhibit area in Cleveland Public Auditorium, is self-evident.

Members of the Executive Board of the Society met in Cleveland on 23 October to complete the programs and activities for the anual convention, certain to set a new high mark in the development of a wider knowledge of the advancements which are being made in the science of industrial finishing.

Not only will there be events of interest for the thousands of production supervisors, engineers, chemists, and purchasing men whose combined orders for services, equipment, and supplies total more than one billion dollars a year, but there will be activities for their wives as well.

Cleveland, on the shore of Lake Erie, has become one of the busiest summer cities in the nation, with shows and shops, parks and museums, beautiful residential sections, and restaurants of every type to suit every taste. Cleveland's hotels are preparing to add their traditional hospitality to make convention attendance a pleasure.

Detailed programs of activities will be published in subsequent issues as they develop. See you in Cleveland in June!

President Schaefer Appoints AES Committees and Liaison Representatives

More than two dozen appointments to various AES committees and liaison representatives to other societies were announced this month by Dr. Ralph A. Schaefer, AES President. They are:

Paper Awards Committee: B. C. Case, chairman, Chicago; R. A. Woofter, Pittsburgh; Q. O. Shockley, Indianapolis.

AES Credentials Committee: F. J. MacStoker, chairman, New York; George Wagner, Newark; Charles Temple, Bridgeport.

Broadening of AES Base: C. Kelly, chairman, Chicago. (Mr. Kelly will appoint the balance of the committee.)

International Council for Electrodeposition (Institute of Metal Finishing): W. R. Meyer, New Haven; W. L. Pinner, Detroit.

Publication Committee: Earl J. Serfass, chairman and editor-in-chief, Allentown-Reading.

Law Committee: G. W. Cavanaugh, chairman, Syracuse; D. G. Foulke, Newark; E. Roth, St. Joseph Valley.

AES Liaison Intersociety Representatives: NTTCIW, C. F. Gurnham, Central Michigan, with D. G. Foulke (alternate), Newark; ASA, George Schore, New York; ORSANCO, W. J. Neill, Columbus; NACE (ISCC), R. M. Wick, chairman, Allentown-Reading; R. E. Harr, Chicago; MFSA, M. M. Beckwith, Cleveland.

AES Representative on ASTM B-8: P. P. Kovatis, Executive Secretary, AES.

AES Research Committee Representative on ASTM B-8: Clarence Sample (Baltimore-Washington Branch).

AES Committee Chairman on ASTM B-8 Specifications: R. Ledford (Chicago Branch).

AES Representative on ASTM D-19: George Best (Baltimore-Washington Branch).

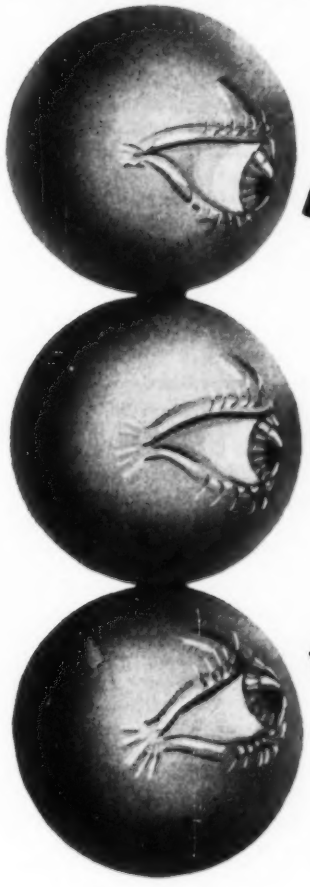
Plating Editorial Board Meets in Cleveland

The world Series failed to distract at least nine loyal AES-ers who journeyed to Cleveland on 1 October. They were members of the PLATING Editorial Board, which convened at the Hotel Statler that day.

Shown at a meeting of the Exposition Committee are: A. W. Erickson, American Decorating Co.; Herb Head, Briggs Mfg. Co.; Irene Grigas, recording secretary; Dr. R. A. Schaefer, Clevite-Brush Devpt. Co, Div. of Clevite Corp.; H. E. Bartlett, American Decorating Co.; E. L. Combs, Diamond Alkali Co.; and H. H. Blouch, Chromium Corp. of America

Cleveland's vast Public Auditorium is located in the center of the industrial finishing industry. The 1955 Industrial Finishing Exposition will utilize the North Hall, Arcade Hall, and the Upper and Lower Level Exhibit Areas

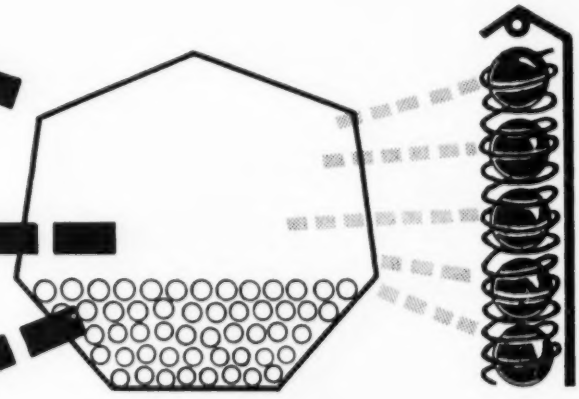
NAPCO ANNOUNCES . . . ITS SECOND CONTRIBUTION TO PLATING PROGRESS . . . .



THE BI-ROTOR* SMALL PARTS PLATER

The plater that UPS production — yet consumes LESS power! The only horizontal rotary plater which offers an unobstructed current flow path.

ONLY THE BI-ROTOR LETS THE ANODES "SEE" THE WORK!



CHECK THESE OUTSTANDING FEATURES — FEATURES FOUND ONLY IN THE BI-ROTOR!

- Increased production volumes.
- Reduced plating power consumption.
- No doors or panels to remove.
- Quicker easier loading and unloading.
- Unobstructed current path from anodes to work.
- Complete immersion of unit without danger of gas entrapment.
- No loss of solution concentration by entrapment in a closed barrel.
- Complete adaptability to modern automation methods.

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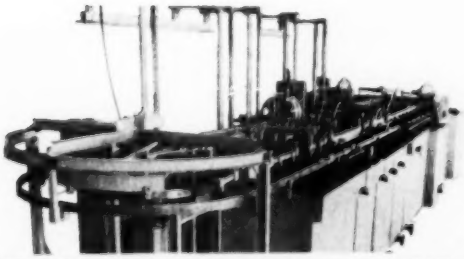
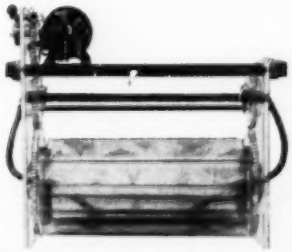


NAPCO'S first step in plating progress — the Lis-O-Matic — fully automatic plating machine. Lis-O-Matics are manufactured under exclusive license by Wagner Brothers, Inc., Detroit, Michigan.



*The latest NAPCO innovation in small parts platers — the Lisowski designed BI-ROTOR — featuring unheard of efficiencies for economic production with lower power costs.

NAPCO

NATURAL PRODUCTS COMPANY, BOX 174 · DEARBORN, MICHIGAN

AES News

The six-hour session was high lighted by action: The board heard a report from J. B. Winters, Cleveland convention educational chairman, who reported five regular educational sessions and one dual session scheduled for the 1955 convention, with at least a dozen papers already promised.

The board voted to recommend to the nominating committee the possibility of considering that a member of the Research Committee serve as liaison to the Editorial Board. Also voted was a recommendation to the Executive Board that all PLATING papers be reviewed by a member of the Editorial Board in addition to two other reviewers.

The board urged that all convention papers which are not available before April 15 be withdrawn.

Plans for a booklet to solicit articles for PLATING were heard from L. Diveley, chairman of the booklet committee, who announced the following appointments to his committee: E. R. Bowerman, Jr., D. Gray, and G. Burnley.

Members who attended the meeting included AES President R. A. Schaefer, Editorial Board Chairman P. Peter Kovatis, AES Past President F. Fulforth, E. R. Bowerman, Jr., L. Diveley, Dr. H. Wiesner, W. Geissman, J. B. Winters, and H. McAleer.

AES Research Committee Meets in Newark

The AES Research Committee, meeting in Newark, N. J., 17 September, named Dr. A. J. Smith as Director of Research Project No. 5 at Michigan State College. Dr. Smith succeeds the late Dr. D. T. Ewing.

The committee has decided on an innovation in publicizing AES research. A sum was appropriated to engage a New York public relations concern to publicize on a "one-shot" basis AES research, with priority to be given to Research Project No. 15.

Secretary P. Peter Kovatis reported that there are now 352 Sustaining Memberships, 312 Sustaining Members, and 7 branch contributors. This is a net loss of 2 members from the previous month and of 3 members from 1 September 1953.

The ORSANCO publication, "Procedures for Analyzing Metal-Finishing Wastes," has now been distributed. This publication, which incorporates the results of Research Project No. 2, will be sold at cost to AES members. The cost price will be less than $1.

AES research will be shown to the industry at the 1955 Industrial Finishing Exposition and AES Convention in Cleveland. A booth has been reserved for a special research display.

The committee authorized an appropriation for an additional fellow for Project No. 12 at Columbia University. Project No. 12 is concerned with research on oil spreading rates at higher temperatures. The appointment of this additional fellow was effective 1 September 1954.

The format of Research Reports will be changed some time in the future since the Research Committee has agreed to overprint research articles in PLATING in the interest of economy. When this change is effective, Research Reports will, of course, be the same page size as PLATING.

Drs. W. Meyer, W. Blum, and W. A. Wesley have been named by Dr. Earl J. Serfass to a project directing committee on microthrowing power.

A suggestion has been received by the Research Committee to establish an additional project at Michigan State College in conjunction with the National Institute of Health and Michigan State College on industrial waste disposal. L. C. Borchert was empowered to set up a task committee to investigate this suggestion and to appoint a project directing committee if the investigation is satisfactory.

The committee also received a suggestion from First Vice-President Kelly for a project on buffing and polishing. Vice-President Kelly will be asked to head a task committee to investigate the possibility of such a project and to give his findings at the next meeting of the research committee.

Myron Diggin suggested a project on insoluble anodes in plating. He was asked to establish a task committee and to report on findings at the next meeting.

Those attending the meeting were: Chairman Serfass, Messrs. Bowerman, Borchert, DuRose, Racine, Wrisberg and Diggin; Drs. Blum and Parker; and Secretary Kovatis.

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DANGEROUS CURVES!

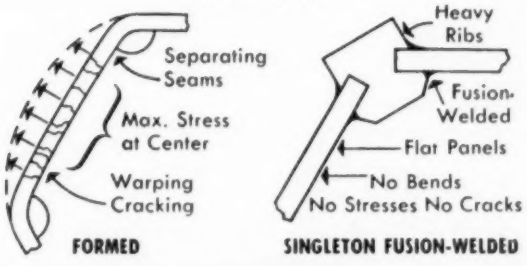
Especially in Plating Cylinders

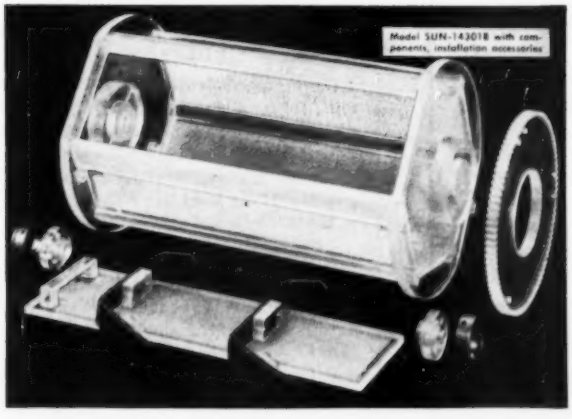
Don't gamble on "formed shapes"! Demand Singleton fusion-welded, heavy-ribbed, flat-panel construction, now the accepted pattern of the industry! Here's the scientific truth about the biggest factor in the success or failure of your plating cylinders. It's not the material, it's the construction!

Plexiglas and Lucite have "plastic memory," say Rohm & Haas and Dupont. Formed plate, when heated beyond its softening point, tends to "return" to its initial flat shape. Severe internal stresses are set-up. Lead to warping, cracking, separating of seams.

No bends or stresses in Singleton construction

(See diagram)





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Here's the plating cylinder value which tops them all! Singleton "H-T Sincolite" Cylinders are rugged, heavy-ribbed, flat panel construction—fusion-welded throughout. Tested, proven superior in all plating cycles and processes, at lower cost. Not only the finest engineered, but also opinioneered by plating men.

Send for Bulletin RC-101, and your "official" card as a "Professional Opinioneer."

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Branch News

BRIDGEPORT

The regular scheduled business meeting and educational session was held 10 September.

The meeting was called to order by President **Bailin** at 8:25 P.M. Twenty-two members and guests were present.

At the roll call of officers **Robert Bonazzo, H. Braun,** and **W. Ehrencrona** were reported absent.

In the absence of Chairman **McNeill,** the secretary reported the result of the recent outing at Woodland Grove.

Mr. **Lovens,** chairman of a committee appointed to assist the University of Bridgeport in forming a class in electroplating, reported considerable progress. Registration for the class was opened on 20 September 1954.

Robert Onkey was appointed chairman of the Christmas dinner-dance. **William Ehrencrona** was appointed chairman of Olde Timers Nite. **V. Consalvo** was appointed chairman of the spring dinner-dance. **Dan Zielik** was appointed chairman of the summer picnic outing.

A motion by **George Eckholm,** and seconded by **R. Goral,** that the branch absorb the cost of site and beer at all future picnics. If necessary, the membership will be assessed not more than $1.00. The motion was passed unanimously.

A motion made and seconded was passed that a letter of thanks be sent to **Art McNeil** for his contributions at the picnic.

The meeting was adjourned at 9:20 P.M. and turned over to **Floyd Tatum,** who arranged for the showing of an excellent color film from the library of the International Silver Company. The progressive development and usage of utensils for the table was well depicted by this pioneer in the development of flat and holloware.

BOB PARKER, *Secretary*

BRANCH PER CAPITA TAX OVERDUE

Many AES members face suspension unless their dues are paid promptly. According to Article VIII, Section 2, of the AES Constitution and By-Laws, members will not only face suspension but will also be deprived of PLATING and other Society benefits.

In addition, a suspended member must pay an additional application fee and back dues in order to be reinstated.

Deadline for per capita remittances to the National Office was September 1.

KOSMOS ELECTRO-FINISHING RESEARCH, INC.

"OLD KOSMOS"

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KER-CHRO-MITE Finishing Chemicals & Processes

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Are you contemplating a change to nickel from Zinc or Cadmium?

1. KER-CHRO-MITE No. 1 for Zinc and Cadmium, brightens and passivates both metals and protects surfaces against finger staining and atmospheric corrosion.

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$0.001-$0.002/sq-ft, **for brilliant finish**
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4. KER-CHRO-MITE No. 1 or 2 needs hardly any control. Good results are obtained at room temperature, and superior results are obtained at mildly warm temperatures.

DON'T MAKE A CHANGE UNTIL YOU SEE "OLD KOSMOS"

now located at

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BUFFALO

The October meeting of the Buffalo branch was held in the form of an educational session on the afternoon of 2 October 1954.

Myron Ceresa of Westinghouse Electric Corporation gave a talk on "Periodic Reverse Copper Plating."

"A Method for Evaluation of Cutting Power of Various Tumbling Media" was the subject of a talk by **H. A. Fudeman** of the Trico Products Corporation, Buffalo.

B. G. Daw of Lasalco, Inc., St. Louis, spoke on the subject of "Barrel Plating."

All lectures were well received and a question period was held following the last speaker. A roast beef dinner was served in the evening, followed by dancing until midnight.

Eric G. Sampson, Jr., *Secretary*

BUFFALO

On Friday 5 November 1954 at 8:00 P.M. **John A. Swift,** Swift Industrial Chemical Company, will speak on the subject, "What a Plater Should Know about Metallurgy," at the Buffalo branch meeting, Hotel Markeen, Buffalo.

CENTRAL MICHIGAN

The annual golf stag day was held on 25 September 1954 at the Washtenaw Country Club, Ypsilanti, Michigan.

A large number of the members plus their guests turned out for the occasion and enjoyed perfect weather for divot

10 REASONS WHY THE COUNTRY'S FINEST COATERS USE

MICCROSOL

VINYL PLASTISOL

FOR INDUSTRIAL COATING!

1 They know that MICCROSOL is the highest quality material they can use.
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5 They can depend on MICCROSOL to keep their reputations, and the quality of their work, at the highest level in the industry.
6 They have helped us develop MICCROSOL to its present point of perfection.
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8 MICCROSOL responds to their skill and experience. Helps them give you the rugged coatings you need to protect work and your equipment.
9 MICCROSOL coatings last longer.
10 They can depend on MICCROSOL!

You can't blame us for being proud of the quality of the coating work produced by our customers. We have worked with them, and for them, to the very best of our ability, during the phenomenal growth of the coating industry. We know them well, and appreciate their loyalty and support. And we hope to have the privilege of serving them all for many years to come.

There's a MICCROSOL Coater located in your vicinity. He's undoubtedly the leader in his field. If you want superior coating jobs, we'll be glad to help you get in touch with him!

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Developed and Manufactured by Experienced Platers

MICCRO Products

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digging, as well as other activities so popular with platers when out with the gang.

A delicious lunch was served to all hands from noon until midafternoon, and in the evening a chicken dinner, family style, was served and enthusiastically received.

The final activity of the day, distribution of the door prizes, followed dinner, and at this time the stag day participants were turned loose to their own devices.

H. W. Boos, *Publicity*

CINCINNATI

This first meeting of the fall season, held 22 September, was attended by 32 members and 5 guests.

President **William Gordon** called the meeting to order at 7:30 P.M. Minutes of the previous meeting were read and approved.

Richard Evans was appointed our delegate to the Tri-State annual dinner-dance. A letter was read from Columbus branch stating that the dance would be held on 26 March and requesting a meeting of all branch delegates on 8 October at Battelle Memorial Institute.

A letter was read from the Dayton branch congratulating Cincinnati on the successful bid for the 1958 National Convention and offering their assistance.

President **Gordon** informed the membership of the resignation of **Charles Sorber,** our first vice-president. Decision of the board of managers to move up the second vice-president to fill this vacancy was made known, and nominations were requested for the office of second vice-president. The names of **Richard Evans, Edwin Roof,** and **Raymond Barry** were presented, and balloting showed **Edwin Roof** to be the choice of the majority of members present—and our new second vice-president.

Exceptions to our regularly scheduled meeting dates were announced—these being 17 November and 14 December.

Roy Critchfield gave a report on our efforts to obtain 1958 National Convention—stating that we were successful. He brought out some of the high lights such as our German Band, competition, etc. Roy said that the local convention bureau has been notified of our successful bid and has reserved the third week of May for the convention. Roy further suggested that we immediately appoint a committee to review hotel facilities, choose convention headquarters, and select a date, with National Headquarters, AES being notified of our results. A steering committee was suggested to promote convention plans.

Critchfield moved that this convention be handled as a joint effort of the branches participating in the Tri-State annual dinner-dance. After considerable discussion, this motion was voted down, with the thought that the board of managers would pursue the merits of such a plan further

Roy Critchfield was given a round of applause for the splendid job done on such short notice.

Bob Miller moved that a committee be appointed to review by-laws of the branch and bring them up to date, including consideration and recognition of past president. Ed Roof was made chairman of this committee with the remaining members to be announced later.

President Gordon appointed the following committee to select 1958 National Convention Headquarters and to choose a date; **Charles Wise,** Chairman; **Ezra Blount, Roy Critchfield.**

Our speaker for the evening was **R. O. Hull,** who gave a talk on "Methods of Testing," illustrated with colored slides. Some time was given to use of Hull Cell in controlling various types of plating solutions. Suggestions were presented covering components of various baths and frequency of checking and analysis to insure good results.

Hull then demonstrated a new method of testing rectifiers by use of the oscilloscope. He went into theory with an explanation of the use of the instrument in detecting common rectifier faults.

L. J. Howald, *Secretary*

CLEVELAND

On 11 September the Cleveland branch held its first fall meeting with a very satisfactory attendance of approximately 75 members and guests.

Just A Minute . . . and YOU can be SURE of the Plating Thickness

with the

KOCOUR ELECTRONIC THICKNESS TESTER

Here's why!

A minute is the time required for the average test . . . a relatively short time to check your work and be sure it's right. No more guesswork checking graphs or charts . . . readings are direct from the instrument panel, accurate to within 90-95%. Now you can determine the thickness of decorative chromium, hard chromium, silver, tin, cadmium, zinc, brass, copper, nickel, lead, tin-zinc alloy and other plating on various base materials and metals including steel, copper, brass, aluminum, plastics, etc. The minimum thickness which can be determined is 2-3 millionths of an inch (2-3 ten millionths for chromium).

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Pioneers in Control Sets for the Electroplating Industry

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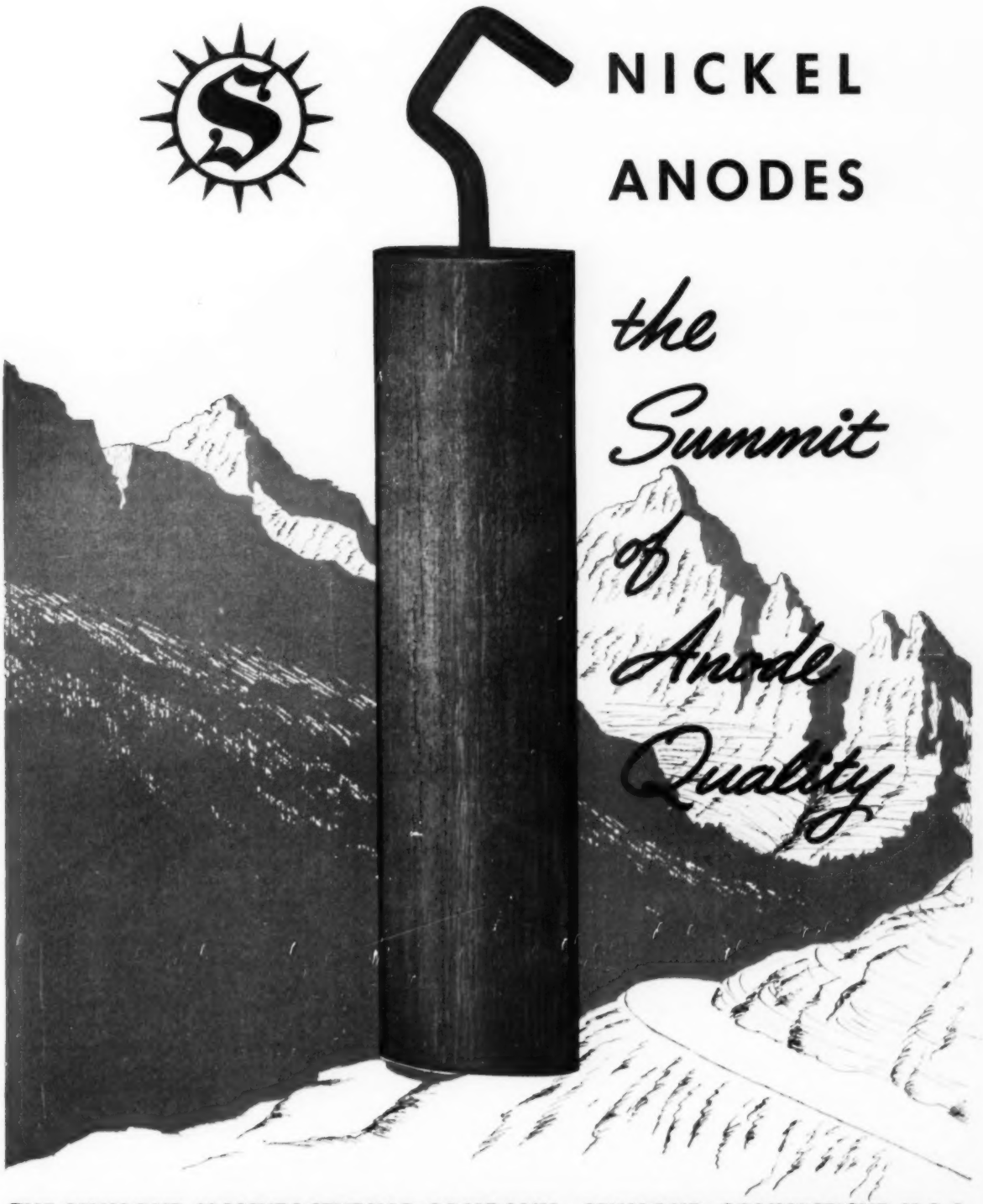

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CONVERT AC TO DC POWER

Closely Regulated Voltage . . .
with the NEW
Magnetic Amplifier • Selenium Rectifier

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regulated
DC POWER SUPPLIES
in Complete, Self-contained Units

- 5 KW to 50 KW MODELS
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AC INPUT
230 volts, 3 phase, 60 cycle 460 volts, 3 phase, 60 cycle

DC OUTPUT Voltage: 125 volts or 250 volts (either voltage obtainable by simple internal reconnection)
Control potentiometer for adjusting DC voltage

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Branch News

The meeting was called to order by President **Henry Friedberg** who, after a brief business meeting introduced **Alfred Erickson,** advertising manager of the American Decorating Company. Erickson discussed the advantages of early reservation of space and the proper placement of advertising material at the Annual AES Exposition to be held in Cleveland next June.

Immediately following Erickson's short talk, President Friedberg introduced **Jack Little,** moderator for a question-and-answer program, which included the following panel members: **R. E. Shaw, W. P. Acks, R. I. Klemm, A. H. Losey,** and **H. P. Heil.** The subjects were directly related to the ever timely topic, "What is Your Plating or Finishing Problem?"

M. Van Loan, Jr.,
Assistant Librarian

COLUMBUS

Following a tour of the Westinghouse plant, a fine lunch and a talk by **Clarence Van Deran** of Westinghouse, after which he was presented with the "Order of the Pot" by **Bill Neill,** the September meeting was opened by President **Bill Schickner,** who thanked Westinghouse for the many favors shown us, and extended greetings to the visiting Dayton branch.

It having been decided to dispense with the reading of the minutes of the previous meeting, the following applications for membership were approved by the branch: **Leslie D. McGraw, Donald E. Swickard,** and **Luther E. Vaaler,** Battelle Memorial Institute; **Robert C. Miller,** K. J. Miller Company; **Grant M. Harris,** Seagrave Corporation; **Willis O. Park, Wilfred R. Burkhart,** and **Evan C. Waltz,** Westinghouse Corporation.

Bill Safranek reported that the Tri-State committee would meet at Battelle Memorial Institute on 8 October 1954.

Our librarian, Bill Neill, reported that the speaker of the October meeting would be **Jim Viola** of Rapid Electric and that rectifiers would be discussed. He also reported a tentative plant trip through North American Aviation for December and a CTC All-Council meeting in November.

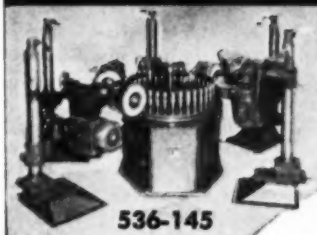
Michael Farb, Jr.,
Secretary-Treasurer

DAYTON

The Dayton branch held its first meeting of the current season on 15 September at the Biltmore Hotel. **John Easton,** president, called the meeting to order, with 19 members and guests present. Two new members were elected: **Harold E. Haber** and **Robert P. Williams,** both of the National Cash Register Company's plating laboratory. Another recent election was **Charles T. Vannorsdall, Jr.,**

ACME *Rotary Automatics*

...cut costs on production finishing



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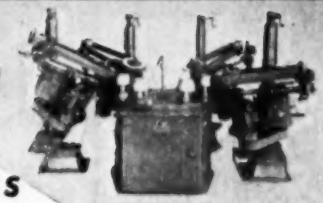

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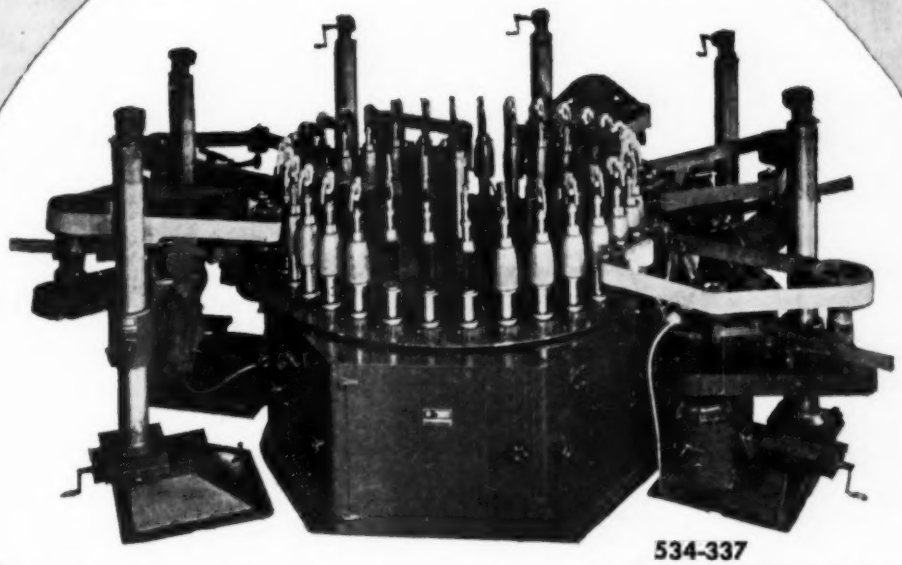

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ACME 8 FT. *Combination Type* ROTARY AUTOMATIC

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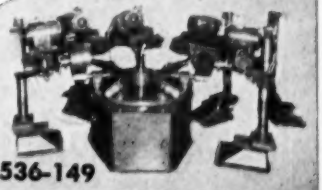

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1. Burned deposit
2. Increase in carbonates
3. Loss in throwing power
4. Roughness
5. Breakdown of addition agents
6. Rapid cyanide breakdown
7. Pitting
8. Excessive gassing and fumes

***Too low a temperature* can result in:**

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2. Spongy deposit
3. Dark plate
4. Restricted current density
5. Lack of color uniformity

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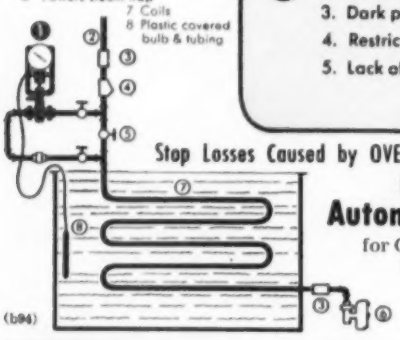

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(b94P)

Branch News

of the Metal Trim Company, Inc., Winchester, Indiana. **Jack Baker**, delegate to the recent convention, gave a report.

Kenneth Shively, the speaker for the evening, was then introduced. He gave a short talk on "Why Make a Will." Shively is a local attorney.

On 10 September the Dayton branch and the Columbus branch toured the new Westinghouse plant at Columbus. Dayton was represented by 55 members and friends and Columbus by 40 members and friends. A fine luncheon was served in the plant cafeteria after the tour. **Clarence Van Derau**, works manager of Westinghouse, past president of the National AES Society, and honorary member of the Dayton branch and of the National AES Society, gave a talk telling us the reasons for the new plant and giving some of the details that must be considered in opening a new plant.

HOUSTON

The September meeting of the Houston branch was held 21 September at the Ben Milam Hotel, with 16 members and 5 visitors in attendance.

Harry Van Wagner was appointed first vice-president to replace **C. R. Feick**, resigned.

New member **Roland C. Adams** and transferee **Paul A. Finn** were welcomed into the branch.

The speaker of the evening, **P. M. Burkhard** of the Wyandotte Chemical Corporation, was introduced by Paul A. Finn.

Burkhard gave an illustrated lecture on the alkalis, phosphates, and wetting agents used in metal cleaning compounds. He discussed the effects of each and how the effects are measured and interpreted.

INDIANAPOLIS

The Columbus, Ind., members of the Indianapolis branch entertained on 6 October at the Central Park Cafeteria in Columbus. Ninety members, wives, and guests attended and a fine dinner was served at 6:45 P.M. The business session was attended by 40 members. After each person introduced himself, the minutes were read and approved. **Herb Kennedy**, first vice-president, reported on membership. The secretary was asked to give a brief report of the national convention; after which **Ed Bruck**, another delegate, gave a few remarks on the convention.

Quentin Shockley, general chairman of the annual dinner-dance, reported the date will be 23 April 1955 at the Indianapolis Athletic Club. There will be an educational session in the afternoon and banquet at night. The following have accepted chairmanships on the committee: educational session, **Robert Van Houten**; sustaining contributions, **John**

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Branch News

Holland; entertainment, **Ed Bruck**; tickets, **Les Reynolds** and **Robert Smith**; printing, **Robert Bruck**; arrangements, **Carl** and **William Niehaus**; favors, **Edna Rohrabaugh**; reservations and hotel accomodations, **Lowell Fisher**.

VanHouten asked for suggestions from the group as to who and what they might like for the educational session. Slips of paper were given to each and the type of speaker and subject were to be suggested.

Kennedy will be our representative at the 8 October meeting at Columbus, Ohio, for the planning of the TriState Regional.

Holland presented to the branch officers six copies of the paper "Some Aspects of Solution Level Control."

MONTREAL BRANCH ANNUAL BANQUET

A part of the crowd of 250 members and guests who attended the Montreal branch annual banquet at Queens Hotel, 1 October. The banquet featured a talk by J. J. Roche, General Chairman of Forty-fourth Annual AES Convention, scheduled for Montreal in 1957, who outlined the plans

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The program following was given by **Dr. Tom Noble**, a surgeon for Indianapolis, whose hobby since 1916 has been the study of the Navajo Indian. Dr. Noble cited very interesting things about the religion of the Navajo, his living and eating habits, his laws, and the various celebrations and feasts of the tribe. He has lived with and visited the tribe numerous times and is an outstanding authority on them. His hobby is unusual but has become something very worthwhile to himself.

Edna Rohrabaugh, *Secretary*

NEWARK

The regular meeting of the Newark branch was held 17 September 1954 at the Robert Treat Hotel.

The meeting was called to order by Vice-President **Tom Austin**.

An application was received from **Charles Covino** and referred to the board of managers. The transfer of **John C. Kosmos** from the Springfield branch to Newark was effected.

It was moved by **M. B. Diggin** that the secretary be empowered to print slips to be distributed to meeting attendants and worn in their breast coat pockets for identification purposes. **D. Foulke** asked for an amendment to permit details to be worked out at the next educational committee meeting. The motion passed.

M. B. Diggin reported that at the New York convention, Newark had again announced its intention to request the 1963 convention at Atlantic City.

It was moved and passed that the secretary write **Gus Bittrich** a letter expressing the appreciation of the branch for the excellent job done in assembling the branch exhibit at the New York convention with which Newark won second prize.

Tom Austin reported that plans for the Christmas party have been made and

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Branch News

asked all to keep 17 December free and to plan to attend.

Cliff Struyk announced the next educational committee meeting would be held 4 October at Hy-Grade Plating, after which he introduced **Lou Donroe** to present the timely topic for the evening.

Donroe announced that he had two items to present, both of which would be more interesting to the group than the announced topic of plating the components of the turbo-encabulator. A complicated formula was placed on the blackboard, which **Ed Bowerman** was able to translate and as a result Ed went home a fifth happier than when he arrived, courtesy of Royal Plating and Polishing Company. Donroe proceeded then to discuss recent developments in chromium plating and to point out that some of the possibilities for the use of chromium may have been overlooked in the past.

George Somerville, of Shell Chemical Company, then discussed the properties, uses, and advantages of epon-type resins for coating purposes. A number of questions after the talk attested to the general interest in the subject.

D. GARDNER FOULKE,
Recording Secretary

NEW HAVEN

The first fall meeting of the 1954–1955 season was held 14 September 1954 at Mason Laboratory, Yale University.

The speaker was **Raymond O'Connor,** Contract Plating Company, Stratford, Conn., who reported on the "International Conference." **John Barry** was the technical chairman.

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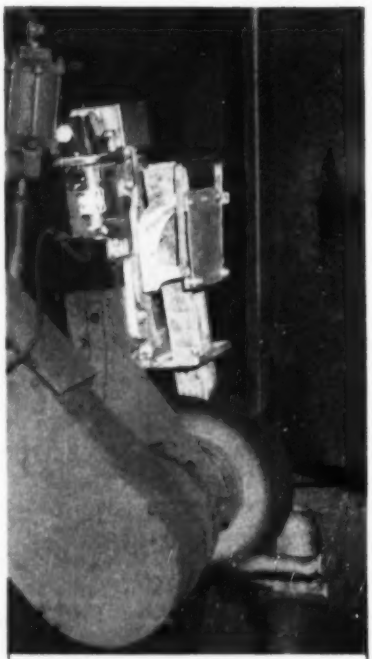
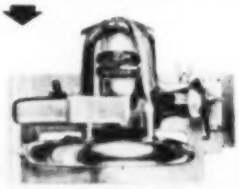


(1) Here's a Nankervis applicator at work

(2) Here's the complex casting



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PHILADELPHIA

The opening meeting of the 1954–1955 season on 24 September started with a dinner at the Broadwood Hotel, with 60 members and guests attending. A short business meeting preceded the program. One in-transfer and three new applications were received.

Clarence C. Helmle, Enthone, Inc., started the program with a half-hour showing of a reel of colored motion pictures that he had taken during a motor tour of Western United States several years ago. Shown were scenes from Yellowstone, Bryce, Grand Canyon, and other National Parks.

The George Gehling Memorial Lecture, a feature of the September meetings of the Philadelphia branch, honoring an AES founder, Supreme Society officer and longtime Philadelphia branch member, was given by **Dr. Earl J. Serfass,** Professor of Chemistry at Lehigh University and AES Research Chairman. His subject was "Analysis of Plating Solutions at the Platers' Level."

His talk dwelt primarily on the use of instruments, such as the colorimeter, for analyzing plating solutions. He also spoke of the variables encountered in the finishing of products; and, as an example of a product variable, discussed the various methods of thickness determination.

Dr. Serfass in conclusion spoke of the work done by AES in setting up standard methods of analyzing metal finishing wastes and their publication under the auspices of Ohio River Valley Sanitation Water Commission.

I. WILLIAM MARCOVITCH, *Secretary*

PHILADELPHIA

The Philadelphia branch will hold its annual educational session and banquet at the Benjamin Franklin Hotel on 20 November.

Featuring the afternoon meeting, which starts at 2 P.M., will be talks by **Henry Brown,** Udylite Corporation, on the "Role of Surface Active Agents in Electroplating Baths"; **Myron Diggin,** Hanson-Van Winkle-Munning Company, on "New Sulfamatic Nickel Process"; and **Joseph Kushner,** head of the Joseph B. Kushner Electroplating School, on "Methods of Control for the Plater." This meeting is open to the public.

The banquet, scheduled for 7 P.M. which will follow the attractive pattern of last year's well-attended affair, will provide door prizes, professional entertainment, and dancing and is expected to draw a large attendance.

SAGINAW VALLEY

The first regular meeting of the 1954–1955 season was opened by President **G. H. Carter** at 8:30 P.M. The chairman welcomed all the members and their guests and introduced the new officers. As each officer was introduced, a quick

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Project No. 2 **Analytical Procedures for Determining Ingredients of Wastes from Plating Plants. Lehigh University.**

Project No. 5 **The Effect of Impurities and Purification of Electroplating Solutions. Michigan State College.**

Project No. 10 **The Disposal of Plating Room Wastes. Yale University.**

Project No. 12 **The Cleaning and Preparation of Metals for Electroplating. Columbia University.**

Project No. 13 **Correlation of the Weathering Behavior of Electrodeposited Coatings with their Permeability to Gases. National Bureau of Standards.**

Project No. 14 **The Influence of the Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating. Ontario Research Foundation.**

Project No. 15 **Accelerated Corrosion Tests for the Performance of Plated Coatings. Firms of Michigan Committee Members.**

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outline of their duties was described by the chairman.

Secretary **Dennis Goddeyne** requested that an effort be made by all members who have not paid their 1954–1955 dues to pay these dues in order that the branch could make payment of the per capita tax to National Headquarters. This tax was due 1 September.

Immediately preceding the meeting, the AES lapel buttons were distributed to all paid-up members present.

Librarian **Paul Beardsley** introduced the speaker, **Dr. Henry Brown,** of the Udylite Corporation. Brown's topic was "The Mechanism of Corrosion," a subject which won him the Heusner Gold Medal Award at the 1954 AES Convention. Brown's presentation of his subject was excellent. He augmented his discussion of copper, nickel, and chrome deposits with a large number of interesting slides and samples. After his talk, Brown answered a number of questions from the floor, which caused a great deal of discussion.

The door prize at this meeting was donated by **Robert Stewart** of Northwest Chemical. **Paul Wackovich** won the prize, which was a Schaffer pen and pencil set.

The meeting was attended by 44 members and guests.

DONALD R. MALTHANER,
Recording Secretary

ST. JOSEPH VALLEY

The first regular meeting of the fall season was held at the Hotel Elkhart, Elkhart, Ind., on 6 October 1954. Twenty-two were present for the dinner, and 24 attended the technical session.

The minutes of the May meeting were read and approved. The secretary-treasurer advised that the paid up membership was 78, and a total of $417.49 was left after per capita tax and all current bills had been paid. Mr. **Wiegand** mentioned the summer picnic at **John Lockerbie's** cottage on 14 August was not quite the success it should have been because so many plater members were not present. Better attendance at next summer's picnic is to be encouraged.

The *AES and YOU* brochure was made available to all members present by the membership chairman, **Ralph Brouwer.** The year's printed program for the St. Joseph Valley branch was acknowledged and the librarian, **Donald H. Kraft,** was complimented for his arrangement of the program and the speakers for this year.

Our president, **John Baymen,** then read a letter the branch had forwarded to the National Secretary to announce the candidacy of **Ralph (Duke) Wysong** for the office of third vice-president at the next National Convention. The active support of each member will be necessary to promote Wysong for a national office.

The meeting was then turned over to **Donald Kraft,** who introduced our guest speaker, **E. W. McAleer** of the Formax Company. His subject was "Polishing and Buffing Materials and Their Applications." A lively question and answer period followed.

Eugene Roth,
Secretary-Treasurer

SAN ANTONIO

Meeting at DeWinnes's Belgium Inn 20 September, the branch heard a talk on "Preparation of Metals for Electropolishing" by **P. N. Burkard** of Wyandotte Chemical Company. Following the talk a question-and-answer session was held.

Roy Rogers urged everyone to attend the October meeting, as the branch will receive its permanent charter at that time.

TOM COLLARD, *Publicity Chairman*

SEATTLE

The September meeting, the first after the summer recess, was held 21 September 1954 at the Stewart Hotel, Seattle, Wash., with the members and guests enjoying a delicious dinner and 6 more persons arriving later for the program.

The program chairman for the evening, **Donald G. Carlton** of Washington Steel Products, Tacoma, introduced **C. B. Holder** of Eagle Metals Company, the Seattle representative of the International Nickel Company. Holder showed the gathering the International Nickel Company film, "Corrosion in Action," a very interesting film on corrosion, how and why it happens, and some methods to prevent it. While the film does not deal directly with the electroplating field,

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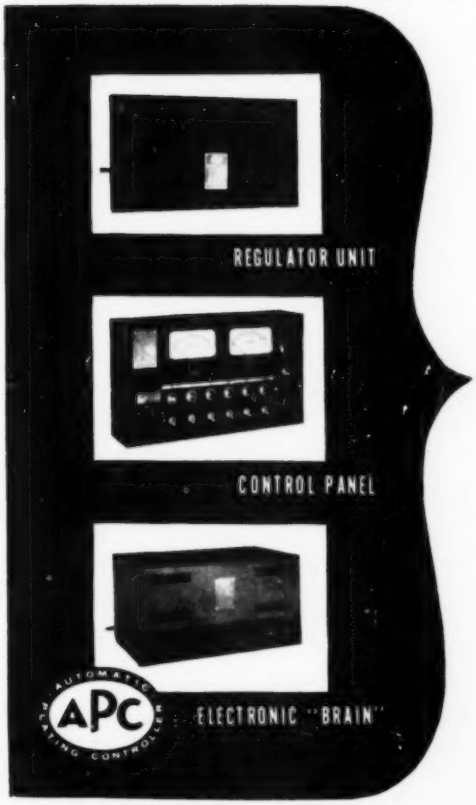

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Branch News

it does have educational value for the basic principles and reactions shown.

After a short discussion the chairman of the branch, **Forster Bradford,** thanked Holder for showing the film and then adjourned the meeting.

HELEN ARCHIBALD, *Secretary*

SOUTHEASTERN

The first fall meeting was held 10 September at the Belmont Steak House. The meeting was called to order at 8:30 P.M., after a steak supper, with 15 members present. **Ray Charles Steffey** presided.

One new member was elected—**E. T. Logan** of Kelite Products, Inc. The speaker of the evening was **Charles L. Anger** of Parker Rust Proof, who gave a talk on phosphate coatings and answered all questions asked. We enjoyed it very much.

W. T. WEYMOUTH,
Secretary-Treasurer

SPRINGFIELD

The Springfield branch opened the 1954–1955 season with a dinner meeting held at Blake's Restaurant. There were 22 members and guests present. The speaker for the evening was **Joseph Haas,** associated with Remington-Rand in the advanced research laboratory. He is also a member of the Bridgeport branch. Haas's subject was "Safety and Health Hazards in the Plating Room and How to Combat Them." He also touched lightly on water conservation and waste control and disposal.

The Springfield branch, through the efforts of **Edward Koetsch, Jr.,** has arranged for a visit to the Springfield Armory on 9 November at 1 P.M. If anyone is interested in this trip, contact Ed Koetsch.

HENRY HEISFELD, *Secretary*

SYRACUSE

The Syracuse branch held its first meeting of the 1954–1955 season at the Club Monarch in Utica, N. Y. The meeting that followed the dinner was attended by 50 members.

The speaker of the evening was **Dr. Nelson F. Murphy** from the Virginia Polytechnical Institute. His subject was "Electrodepositing of Aluminum." Murphy is a past president of the Syracuse branch.

Refreshments were provided by the Syracuse branch, which was considered to be the best way in which all could benefit from the money received from winning the membership contest.

A. G. MARTINEAU, JR.,
Recording Secretary

SYDNEY

Owing to the sudden departure to Melbourne of the evening's lecturer, a discussion night was held in August. This was an interesting substitute. Two films were also shown, "The Queen's Visit to Australia" and "The Redex Trial of 1953."

At the September general meeting, Librarian **B. Bridgement** introduced **D. Glanville** of Bristol Aviation Services Pty., Ltd. Glanville is their machine shop and plating foreman and was previously employed by Trans-Australia Airlines as electroplating and heat treatment foreman.

He was, therefore, well qualified to deliver his lecture on "The Application of Electroplating to the Aircraft Industry," which was well received.

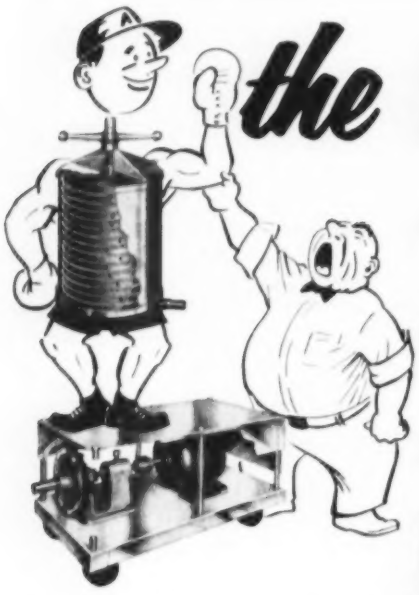
WICHITA

The Wichita branch opened its new season with a meeting attended by 28 members. The meeting was held at the El Charro, a new meeting place for this branch.

An excellent talk was given by **R. W. Kotz** of the Belke Manufacturing Company, Chicago, on "Plating Room Construction and Maintenance." The discussion afterwards answered many pertinent questions.

The Wichita area is just now getting into the problem of plating plant waste disposal. On 24 November our speaker is to be **Dr. Leslie E. Laney,** on "Cyanide and Chromium Waste Disposal." To this meeting have been invited representatives of the State Board of Health and the City of Wichita. We are attempting to show that this Society is aware of its problem and is trying to do something constructive about it. To this meeting will also be invited all others in our area who have problems of waste disposal of chemicals.

Russel H. Beatie
Publicity Chairman



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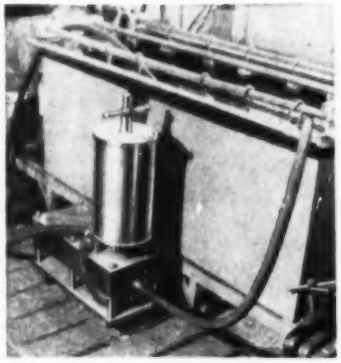

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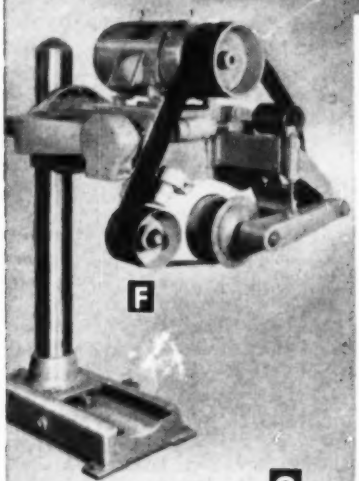

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DETROIT: Edward Finnie to Springfield, William N. Dunlap, Jr., to Philadelphia
HOUSTON: Walter B. Ellis from Dallas-Ft. Worth, P. A. Finn from Dallas-Ft. Worth, C. Murray to Dallas-Ft. Worth
MILWAUKEE: G. S. McCormick from Bridgeport, R. Servatius to Rockford
PHILADELPHIA: William N. Dunlap, Jr., from Detroit
SPRINGFIELD: Edward Finnie from Detroit, John C. Kosmos to Newark
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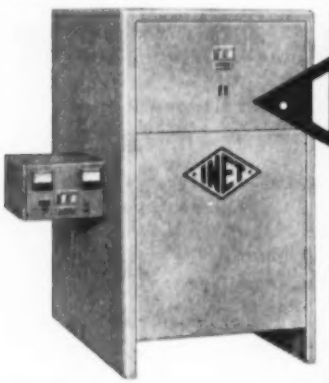

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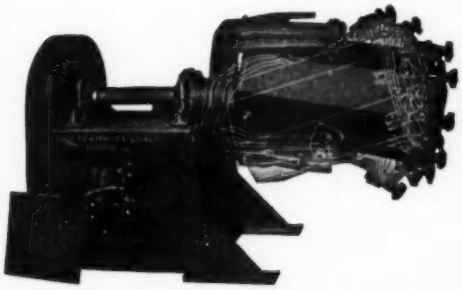

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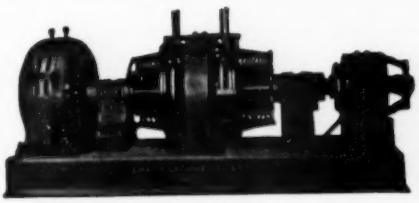

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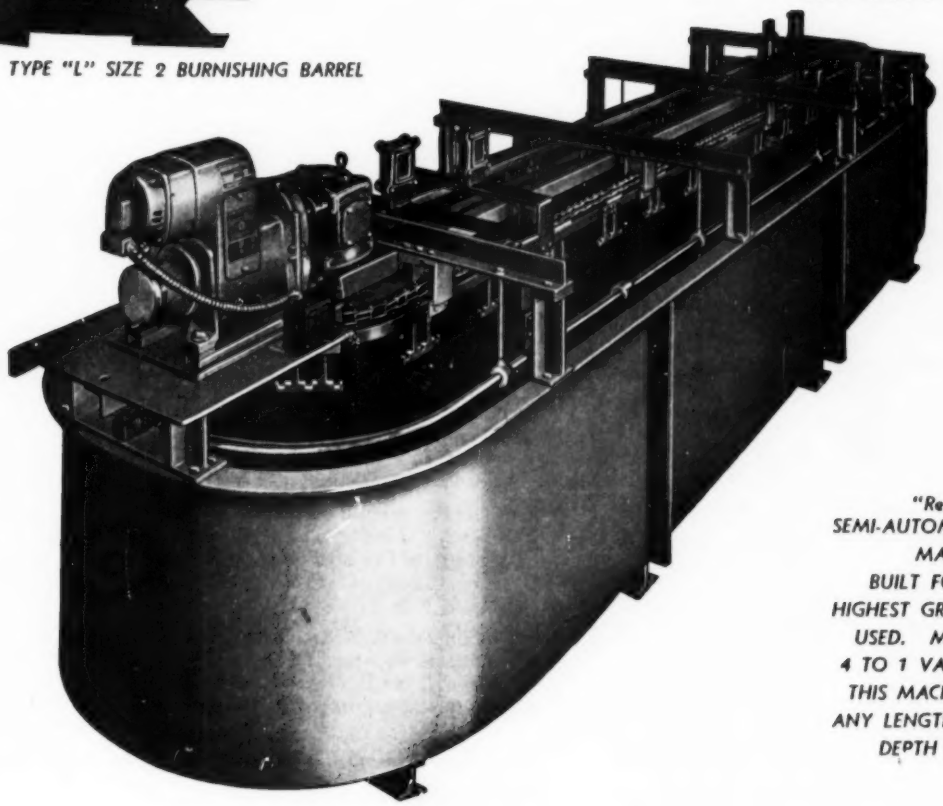

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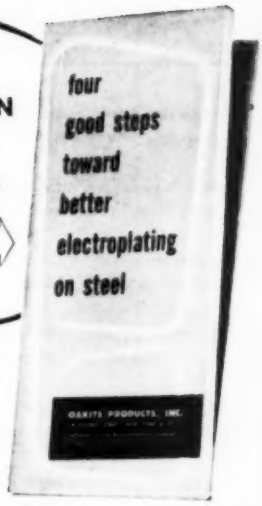

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- ¶ Why is it better to clean steel with reverse current than with direct current? *See pages 12 to 14.*
- ¶ What causes hydrogen embrittlement during electrocleaning? What is the remedy? *See pages 15 and 16.*
- ¶ One part chromic acid in 1,000,000 parts of cleaning solution—does that spell D-A-N-G-E-R? *See page 16.*
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Future Meetings

MINERALOGICAL SOCIETY OF AMERICA, annual meeting, Los Angeles, November 8–10.

FIFTH NATIONAL STANDARDIZATION CONFERENCE, Hotel Roosevelt, New York, November 15–17.

FEDERATION OF PAINT AND VARNISH PRODUCTION CLUBS, annual meeting, Palmer House, Chicago, November 18–20.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, annual meeting, Hotel Statler, New York, November 28–December 3.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, New York, December 12–15.

AMERICAN SOCIETY FOR TESTING MATERIALS, 1955 committee week, Cincinnati, January 31–February 4, 1955.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, annual meeting, Chicago, February 13–17, 1955.

AMERICAN CHEMICAL SOCIETY, 127th meeting, Cincinnati, March 29–April 7, 1955.

42ND ANNUAL AES CONVENTION AND 4TH INDUSTRIAL FINISHING EXPOSITION, Municipal Auditorium, Cleveland, June 20–23, 1955.

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